BULLETIN NO. 1.

OF THE

WEST VIRGINIA

Agricultural Experiment Station

AT

MORGANTOWN, W. VA.

Organization and Work of the Station,

JULY 1888.

JOHN A. MYERS, Director.

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Secretary,
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Officers and Staff of the West Virginia Experiment Station.

Director and Chemist,	John A. Myers.
Dairyman,	A. C. Magruder.
Assistant Chemist,	
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Meteorologist and Assistant Chemist,	A. R. Whitehill.
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Ornithologist,	William D. Doan.
Botanist,	
Veterinarian,	
Agriculturist,	
Horticulturist.	
Stenographer and Book-keeper,	

ORGANIZATION AND WORK OF THE STATION.

BY JOHN. A. MYERS, DIRECTOR.

The West Virginia Agricultural Experiment Station was organized in June, 1888, by the Board of Regents of the West Virginia University accepting the Congressional Appropriation, dividing it into separate funds, electing a director, appointing suitable committees and indicating an outline of the work to be undertaken for the next year.

The Board finds itself without any buildings for the Experiment Station, without any farm for experimental work, and with no money, outside of the restricted appropriation for building purposes, with which to provide either. The Director found the Station without a staff of scientific workers and with no place to put them if he had them.

It will thus be seen that we are starting with the foundation. It need not be expected that the Station can accomplish much scientific work until we have had time to overcome the difficulties facing us.

It is hoped that the farmers of West Virginia will press the matter of agricultural education in our State so vigorously in the near future that our legislature will be constrained to provide for the promotion of a more profitable system of agriculture. The National government has been liberal to this State, and particularly to the farming classes, in its endeavors to develop agricultural interests. The question may be asked very seriously, "What has our State done to avail itself of the munificence of the General government?" To what extent has it supplemented the efforts of our National government to develop the agricultural interests of this State and to educate our farming classes? Why should not this State, as other States, receiving the land grant of 1862, make provisions that the farmers of this State, as in other States, receive the benefits of scientific work in agriculture? Why not have an experimental farm and

farmers carefully trained for the business, just as we have educated doctors, lawyers and preachers for their respective callings.

I am fully aware that popular prejudice, in some quarters, is strong against educated farmers, just as it was years ago against educated doctors and lawyers when people preferred to have nothing to do with them. It was only one hundred years ago that the innocent exposure of an arm at the window of a New York hospital led to a riot that seriously injured a number of prominent citizens; and when even the New York papers contained the following: "Are we not convinced by this time that we have among us a set of men so audacious that they venture, even in public, to wrest, turn, and twist and explain away the purport and meaning of our laws? Beware of the lawyers."

Let our farmers insist that their interests shall receive attention in our legislative halls equal to their importance, and insist that this Experiment Station be provided with land and proper facilities for successfully carrying on its work. It is for the benefit of the farmers alone, and it is their duty to watch it with a jealous eye and see to it that it is properly provided for, wisely conducted, and held strictly to the purposes for which it was organized.

If our farmers do not look after it, profit by its work, and support it, there is no class of people in the State for which it is intended, and a further continuation of the appropriation on the part of the government would scarcely be justified.

It is the desire of the Director to come into close relations with the farmers, to find what are the most pressing needs, and as far as is in his power, to concentrate the energies of the Station-workers upon those subjects. It will always be his aim to bring the scientific work of the Station into actual bearing upon the practical questions of Agriculture, trusting that the work upon such problems as are undertaken may lead to results that will prove of advantage to the farmers.

For some time, until facilities can be perfected for carrying on experimental work upon a large scale, we shall be forced to confine our bulletins to the distribution of scientific work reduced to a popular form, the matter being drawn from such sources as may be available.

THE OBJECTS OF THE EXPERIMENTAL STATION.

This is clearly given in the 2nd section of what is known as the Hatch Act; "That it shall be the object and duty of said Ex-

periment Stations to conduct original researches or verify experiments on the physiology of plants and animals; the diseases to which they are severally subject, with remedies for the same; the chemical composition of useful plants at their different stages of growth; the comparative advantages of rotative cropping as pursued under a varying series of crops; the capacity of new plants or trees for acclimation; the analysis of soils and water; the chemical composition of manures, natural and artificial, with experiments designed to test their comparative effects on crops of different kinds; the adaptation and value of grasses and forage plants; the composition and digestibility of the different kinds of food of domestic animals; the scientific and economic questions involved in the production of butter and cheese; and such other researches or experiments bearing directly on the agricultural industry of the United States as may, in each case, be deemed advisable, having due regard to the varying conditions and needs of the respective States or Territories." From this it will be seen that the whole range of agricultural science bearing upon Agriculture may receive attention.

For the present, we shall attempt but few of these subjects.

The situation of West Virginia with respect to the Eastern markets and to the large manufacturing centers like Pittsburg and Wheeling would lead one to suppose that we could readily find a good market for anything that the farmers could produce. This may be true in most cases, but the profits in farming do not depend wholly upon the selling price of the products, though frequently our farmers figure it without any regard to the cost of production.

We find, in many sections of the State, farmers cultivating wheat and corn upon steep hill-sides by hand, trying to compete with the great West, where the crops can be grown and harvested by machinery at perhaps one-third of what it costs to produce the same here. For example, a mill owner in this town has told me that he can buy corn delivered here, free of freight at about 15 cts. less per bushel than the farmers here can possibly produce it. Under such conditions as these it would scarcely appear to be a rational undertaking to raise corn in this section, unless it can be used with the fodder produced, in such a way as to make it profitable by fattening cattle; but in this business it is doubtful whether, under the light of a careful analysis, any profit can be shown.

The sheep industry, while the price of wool is so low, is scarce-

ly a profitable business; though even at present figures perhaps one of the safest and best businesses pursued by our farmers. The fattening of hogs is not a profitable business for the reason that the corn costs so much. The raising of horses and mules should be profitable in very many cases, and I believe has generally been found to be so, where tried.

Our farmers while working hard from early to late scarcely make more than a fair living for themselves and families. Few, it is true, are in debt, but few are making much money. Why is this? My idea of farming is to make money by the business, and thereby accumulate property without impoverishing the land, as is done in most purely agricultural countries.

Taking everything into consideration, we know of nothing that offers more advantages to those farmers who are within reach of our railroads than does the dairy business, and the first effort of the Station will be to develop this industry in the State, believing, as we do, that it offers a more profitable business and a safer one, than anything the farmers of the State are engaged in, or can engage in. This is naturally a dairy country, and it is simply following the line nature has marked out for us in adopting this business. The dairy will constitute the entering wedge of our work. With farmers engaged in the dairy business, it is not long until the questions of food stuff, and all the complicated problems connected with it, arise; such as grasses best adapted to the country, preservation of forage and grain crops, ensilage, silos, economic feeding, scientific feeding of stock for butter, milk and meat; the economic questions connected with the raising of cattle, improved and thorough bred cattle, diseases of stock, covering the whole range of veterinary science; improvement of land, preservation of pasture and rotation of crops, together with the study of the diseases of the crops, their enemies and best means of protection.

We are fully aware that it may take several years to accomplish much and that we may be met by the impatience of inexperience, and charges of varions kinds, but we are very sure we are upon the right foundation upon which to build experimental work in this State.

The most serious question in our mind is, whether the farmers of the State will take enough interest in the work and assist to a sufficient extent to make the Station a success. We ask them to help us, to study our work, to profit by our failures and to take advantage of our successes, and we promise to leave no ef-

fort untried to make The Experiment Station a blessing to the farming interests of the State.

We propose to press the development of the dairy interest in this State with as much earnestness as possible. Besides offering the advantages that it does as an entering wedge for our experimental work, it has the advantage of every other operation upon the farm, when looked at from a money-making stand point. In all other farm enterprises, the farmer must wait from six months to a year or more before he receives any dividend from his investment. In the case of wheat, corn, or other crops, the farmer must run the risk of a half dozen accidents, as drouth, frost, rust, insects, etc., and take the chances of a low market when the harvest has come. His capital, his labor, his hopes are all staked upon the chances of his crop escaping the enemies, and prices not being depressed by the whims of the "Bears" of the Chicago Exchange.

This is not the case in the dairy business. In it the farmer begins to collect his dividends the next month after he invests his capital and labor, and his money comes in regularly as long as he keeps his cows in milk and takes proper care of them.

One of the most serious troubles with our farmers, is, that they rarely know the cost of anything produced upon their farms. Many whom this bulletin may reach, may be disposed to say, "Ah! the dairy business is a little business. I let my wife and the girls have what they can make off of our cows." That is, in a measure, true. We will suppose that he keeps five cows the year around. Has he ever calculated the influence this "little business" of "his wife and girls" has upon the home? When we think of it, is it not a fact that from the proceeds of those five cows, his wife buys three-fourths of his groceries, clothes the small children, buys all the better clothing for herself and the girls, and occasionally, when he is "in a pinch" loans him a dollar or so to help him out? Yes, it is a "little business," but as his wife and the girls carry it on they make it pay more than the half of his farm is now paying. That "little business" with the five cows has supplied him with groceries, kept him in milk and butter, raised enough meat to more than half supply his family, bought the larger share of the clothes for the family and met a dozen other little wants of which he knew nothing. Is it a "little business?" What do those cows pay? Who will answer? Who has the figures? If you do not have the figures, it may be well to consider the following: An average cow in this

country should produce not less than 200 lbs. of butter a year, which, at 20 cts. is $40.00; and the skimmed milk left unaccounted for. Where farmers patronize Creameries as they should do, this is less than the mininum price at which the butter is sold. You can buy the cow for from $30 to $40.00. Let the skimmed milk and manure pay the expense of keeping her and you have a net profit of how much? How many such cows does it take to make more money than the whole farm is now paying? Why is it that all over the United States those sections engaged in the dairy business are in the most prosperous condition, the farmers out of debt, living in ease and elegance, with money to loan, and time to enjoy themselves as other men do? Is it not due to the regular and never failing supplies of cash that is distributed every week in those sections? In this business, the farmer has something at hand all of the time to convert into money.

In pressing this matter to the attention of our farmers, we believe we are laying the foundation for a much greater agricultural prosperity in our State, and those farmers who will profit by the experience elsewhere in this business, will find it more profitable to engage in the dairy business than anything else, outside of restricted sections, such as the river bottoms near Wheeling, etc., where, of course, truck gardening will pay best.

We are very sure of the foundation upon which we are trying to build up the experimental work of the station, and as the scheme is perfected and facilities for carrying it out are placed in our hands, we have not the slighest doubt that our farmers will get a greater benefit from the Experiment Station than by any other plan that could be adopted.

We ask the farmers of the State, the State Grange, the Co-operative associations and Live-stock associations in the State to give us their hearty support; to correspond with us, giving their experience and advice. We will make it our business to attend their meetings, as far as possible and trust that they will correspond with us in regard to all matters of importance connected with tbe development of the State. Everything that we can do will be done absolutely free of cost to them.

We likewise ask the support of all patriotic and enterprising citizens in the State and trust that all of the various interests of commerce and manfactures may give us their influence for building up the wealth of our farmers, as this is, and must al-

ways be, the foundation of our prosperity. Give us your helping hand, and in helping the development of our agricultural interests you help yourselves. It must all come back to you in increased trade and larger supplies of raw materials and the necessaries of life.

We also appeal to the press of the State to give us its powerful arm. With a kind support from it, we have no fear of failure. We ask all of our State papers to help us to keep the work of the Station before the farmers. We cannot reach this class of our citizens except by persistent and continual effort and the press must always be the lever by which they are moved. It is an enterprising press which, more than anything else, continually calling attention to the advantages of the country has built up the great West. The influence is so powerful that our young men—the cream of the country—as fast as they become of age, move West, leaving a country which is, in many respects better, and in few, as bad as a new country to which they go; but the influence of the press inspires a faith in better things and off they go, frequently without money to get back and they are forced to remain. Let our State press give us its hand to help put a stop to this draining of our country of its life-blood and try to build up our interests at home. Will our editors give us their help and second every effort, however feeble, to develop a larger prosperity in our State?

We ask the patience of the public. It is not a small undertaking to organize an Experimental Station under any circumstances; but it becomes doubly difficult when we are lacking many of the most essential conditions to success. It will take time to supply what is wanting, and our work must not be judged by the same standard, as it should be, had we a complete organization and a trained force of scientific workers provided with all of the facilities for carrying on their work.

In order to secure a complete list of the farmers of the State to whom we desire to send all of our Bulletins free, we shall address every postmaster in the State, requesting them to send us a list of the farmers receiving their mail at their respective offices. In this way, we hope to receive the addresses of from 8,000 to 10,000 of our farmers, but there will be many post-masters who will probably not reply to our request, and any citizen desiring to have our publications sent to him as they appear, will secure them by sending us his address.

The Director will be especially glad to meet the farmers in

their conventions, and we hope that our friends will notify us of the time and place of their meetings and the Station will always endeavor to have a representative present to take part.

There is one caution that we desire to throw out at the beginning of our work, and that is that our Station Laboratory is not intended as an advertising medium for mineral springs, minerals or mining schemes. All specimens sent in for examination will be held until such time as we can attend to the work economically with other work of the same kind. All samples received here, which upon their face bear evidence of an attempt to secure private profit at public expense, will not receive attention. Our Laboratories will be equipped for the special kind of work contemplated in the law, and we hope that this will be carefully noted and remembered.

We will test any kind of seeds as to purity and germinating power; examine soils, grasses, fodders, feed-stuffs, weeds, insects, insect powders, fertilizers, moulds, fungi; investigate prevailing diseases among animals and plants; experiment on adaptability of various species of grains, fruits, grasses and forage crops; assist in organizing Creameries and give instruction in dairy practice, and in the art of dehorning cattle. We will make milk tests of cattle where public benefit is derived from the same and will give instruction in any of the methods employed at the Station, free of charge. We will supply the farmers with plans for building creameries and equipping same; give plans for building silos. As soon as our organization can be perfected, we hope to be able to carry on with our work of a popular character, scientific investigations that may contribute original matter for the advancement of our knowledge of Agricultural subjects.

We have not the slightest doubt that we can make the Experiment Station of lasting benefit to the farmers of our State upon the plan of work outlined, and ask all to have patience and give the authorities of the Station time to overcome the difficulties presenting themselves at its very organization. Buildings can not be erected, lands secured, experiments inaugurated and completed, scientific workers selected and employed, and all of the many perplexing problems connected with organization and equipment solved, in a few days. It will take time, patience, forbearance and encouragement together with material aid, to accomplish the work. Will our farmers, our patriotic citizens, our legislators, and above all, the press of the State, give us that support that we require to make our work a success?

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

That in order to aid in acquiring and diffusing among the people of the United States useful and practical information on subjects connected with agriculture, and to promote scientific investigation and experiment respecting the principles and applications of agricultural science, there shall be established, under direction of the college or colleges, or agricultural department of colleges, in each State or Territory established, or which may hereafter be established, in accordanc with the provisions of an act approved July 2, 1862, entitled, "An act donating public lands to the several States and Territories which may provide colleges for the benefit of agriculture and the mechanic arts," or any of the supplements to said act, a department to be known and designated as an "Agricultural Experiment Station;" *Provided*, That in any State or Territory in which two said colleges have been or may be so established the appropriation hereinafter made to such State or Territory shall be equally divided between such colleges, unless the legislature of such State or Territory shall otherwise direct.

Sec. 2. That it shall be the object and duty of said Experiment Stations to conduct original researches or verify experiments on the physiology of plants and animals; the diseases to which they are severally subject, with the remedies for the same; the chemical composition of useful plants at their different stages of growth; the comparative advantages of rotating cropping as pursued under a varying series of crops; the capacity of new plants or trees for acclimation; the analysis of soils and water; the chemical composition of manures, natural or artificial, with experiments designed to test their comparative effects on crops of

different kinds; the adaptation and value of grasses and forage plants; the composition and digestibility of the different kinds of food for domestic animals; the scientific and economic questions involved in the production of butter and cheese; and such other researches or experiments bearing directly on the agricultural industry of the United States as may in each be deemed advisable, having due regard to the varying conditions and needs of the respective States or Territories.

Sec. 3. That in order to secure, as far as practicable, uniformity of methods and results in the work of said Stations, it shall be the duty of the United States Commissioner of Agriculture to furnish forms, as far as practicable, for the tabulation of results of investigation or experiments; to indicate, from time time, such lines of inquiry as to him shall seem most important; and, in general, to furnish such advice and assistance as will best promote the purposes of this act. It shall be the duty of each of said Stations, annually, on or before the first day of February, to make to the Governor of the State or Territory in which it is located, a full and detailed report of its operations, including a statement of receipts and expenditures, a copy of which report shall be sent to each of said Stations, to the said Commissioner of Agriculture, and to the Secretary of the Treasury of the United States.

Sec. 4. That bulletins or reports of progress shall be published at said stations at least once in three months, one copy of which shall be sent to each newspaper in the States or Territories in which they are respectively located, and to such individuals actually engaged in farming as may request the same, and as far as the means of the Station will permit. Such bulletins or reports and the annual reports of said Stations shall be transmitted in the mails of the United States free of charge for postage, under such regulations as the Postmaster-General may from time to time prescribe.

Sec. 5. That for the purpose of paying the necessary expenses of conducting investigations and experiments, and printing and distributing the results, as hereinbefore prescribed, the sum of fifteen thousand dollars per annum is hereby appropriated to each State, to be especially provided for by Congress in the appropriations from year to year, and to each Territory entitled under the provisions of section eight of this act, out of any money in the Treasury proceeding from the sales of public lands, to be

paid in quarterly payments, on the first day of January, April, July and October in each year, to the treasurer or other officer duly appointed by the governing boards of said college to receive the same, the first payment to be made on the first day of October eighteen hundred and eighty-seven; *Provided, however,* That out of the first annual appropriation so received by any station an amount not exceeding one-fifth may be expended in the erection, enlargement or repair of a building or buildings necessary for carrying on the work of such station; and thereafter an amount not exceeding five per centum of such annual appropriation may be so expended.

Sec. 6. That whenever it shall appear to the Secretary of the Treasury, from the annual statement of receipts and expenditures of any of said stations, that a portion of the preceding annual appropriation remains unexpended, such amount shall be deducted from the next succeeding annual appropriation to such station, in order that the amount of money appropriated to any stasion shall not exceed the amount actually and necessarily required for its maintenance and support.

Sec. 7. That nothing in this act shall be construed to impair or modify the legal relation existing between any of the said colleges and the government of the States and Territories in which they are respectively located.

Sec. 8. That in States having colleges entitled under this section to the benefits of this act, and having also agricultural experiment stations established by law, separate from said colleges, such States shall be authorized to apply such benefits to experiments at stations so established by such States; and in case any State shall have established, under the provisions of said act of July 2d aforesaid, an agricultural department or experimental station, in connection with any university, college, or institution not distinctively an agricultural college or school, and such State shall have established or shall hereafter establish a separate agricultural college or school, which shall have connected therewith an experimental farm or station, the legislature may apply, in whole or in part, the appropriation by this act made to such separate agricultural college or school; and no legislature shall by contract express or implied disable itself from so doing.

Sec. 9. That the grants of money authorized by this act are made subject to the legislative assents of the several States and Territories to the purposes of said grants: *Provided,* that pay-

ments of such installments of the appropriation herein made as shall become due to any State before the adjournment of the regular session of its legislature meeting next after the passage of this act, shall be made upon the assent of the Governor thereof, duly certified to the Secretary of the Treasury.

Sec. 10. Nothing in this act shall be held or construed as binding the United States to continue any payments from the Treasury to any or all States or institutions mentioned in this act, but Congress may at any time amend, suspend, or repeal any or all of the provisions of this act."

Under the provisions of this act, the Agricultural Experiment Station for West Virginia is located at Morgantown, in connection with the State University which received the proceeds of the "land grant" under the act of Congress of July 2d, 1882.

BULLETIN NO. 2.

OF THE

WEST VIRGINIA

Agricultural Experiment Station

AT

MORGANTOWN, W. VA.,

OCTOBER 1888.

The History, Properties, Source of the Ingredients, Mode of Application, and Uses of Commercial Fertilizers.

BY A. R. WHITEHILL.

JOHN A. MYERS, Director.

Board of Regents of West Va. University.

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Ornithologist,	WILLIAM D. DOAN.
Botanist,	
Veterinarian,	
Agricultnrist,	
Horticulturist,	
Stenographer and Book-keeper,	

COMMERCIAL FERTILIZERS.

BY A. R. WHITEHILL.

Agriculture in recent years has developed into a science. Not that its underlying principles are yet thoroughly understood, but they have been carefully classified and studied, and many of them are capable of experimental demonstration. In its various departments agriculture is, in fact, a combination of all the other sciences. In the formation of soils and classification of plants, in the study of the various forms of animal life and in tracing the effects of different climatic conditions upon various crops, the sciences of geology, botany, anatomy and meteorology give valuable aid, while by the laws of physics and chemistry the use of machines is explained and the various forces of nature are interpreted.

While a knowledge of all these sciences is necessary to a correct understanding of the principles of agriculture, yet chemical science has been especially active in the interests of the farmer. There is hardly an operation performed on the farm which has not a direct bearing upon chemical science, and the study and explanation of these various operations may well claim the attention of the agriculturist. In the development and growth of the commercial fertilizer trade during the last half century, the importance of chemistry in agriculture has been especially marked, and plant food is now prepared with the same scientific care as that intended for animals or man.

With the introduction of Peruvian guano into Europe the trade in commercial fertilizers may be said to have begun. It is true before this time crushed bone had played an important part in European agriculture, but its fertilizing properties were ascribed wholly to the animal matter which it contained. It

was not until about fifty years ago that the keynote to scientific farming was struck by the Duke of Richmond when he affirmed that fertilizers owed their value largely to the phosphoric acid which they contained, and about the same time Boussingault in France and Liebig in Germany arrived at the same conclusion.

This statement, vouched for by such eminent authority, that the mineral food of the plant, as furnished partly by the earthy matter of the bone, was the important factor in agriculture was soon subscribed to by the other scientific writers of the countries named, and soon the expediency of manufacturing fertilizers began to be discussed. Not that the time was yet ripe for their immediate use, but so strong was the belief in the possibility of their preparation that Liebig in his famous work on chemistry made use of the following significant sentence : "A time will come when plants growing upon a field will be supplied with their appropriate food prepared in chemical manufactories, when a plant will receive only such substances as actually serve it for food, just as at present a few grains of quinine are given to a patient afflicted with fever, instead of the ounce of wood which he was formerly compelled to swallow in addition."

THE ORIGIN OF FERTILZERS.

Even at this time guano was being imported in small quantities into Europe, and so marked were the results from its application that the subject of artificial plant food became at once prominent in scientific agriculture. Without understanding its action, farmers soon saw that by the use of the substance the fertility of new fields could be increased and barren tracts could be reclaimed. They saw that larger and better crops could be obtained by its application than by the use of any other fertilizer then known, and quickly drawing out of the ruts into which they had fallen, a more lucrative system of farming soon prevailed.

When they saw, too, in the increased production of their farms what remarkable results would follow the use of a product, which, though expensive, required so little labor to handle and apply, they were easily induced to try other artifi-

cial substances which soon began to be introduced. From this beginning sprang the immense fertilizer trade of the present, a trade which has erected the chemical manufactories foretold by Liebig in nearly every part of the globe, and which will increase in importance as lands become less fertile and the demand for food increases.

THE TRADE IN WEST VIRGINIA.

In West Virginia the trade is yet in its infancy as compared with it in some of the Eastern and Southern States, but it is becoming more extensive every year. New brands are being introduced, and the quality of the older brands, in many cases, is being improved. Every variety of soil and climate being found, every variety of fruit and grain and root crops can be successfully cultivated, and both immigration and a more advanced system of farming are adding to the farmer's wealth. In the older States farmers have long since learned, and many of them by sad experience, too, that valuable constituents cannot be taken from the soil and sold off the land, whether in the shape of grain, fruit, wool, dairy products or otherwise, without selling also valuable ingredients of the soil, and unless these ingredients be returned, crops will refuse to grow and fertility will cease. The worn out tobacco lands of many of the Southern States and the decrease in the production of wheat and other grains in many of the Northern States is a familiar illustration of the above fact, and it is the rule everywhere that unless the loss of mineral ingredients be made good, no land can be continually cropped without being the worse for the cropping.

In consequence of the growing importance of the fertilizer trade in West Virginia, it is proposed in this paper to inquire into the source and properties of the various substances that are being placed on the market, to give some practical information concerning their value and use, and thus aid the farmer in selecting that material which his soil and crop may require.

THE FOOD OF THE PLANT.

It is now generally conceded by agriculturists that plant cells are never formed except in a fluid containing oxygen, hydrogen, nitrogen and carbon. These four elements are

generally termed the organic constituents of the plant, and so essential are they to its growth that they form the greater part of its structure. Existing in the atmosphere in the form of carbonic acid, water, ammonia and nitric acid, they find their way into the soil, and the simplest cell has the power to assimilate them. The hydrogen and oxygen form the water, which is the most abundant constituent of all. Three-fourths of the weight of many plants is merely water, while in beets, carrots and the succulent vegetables the proportion is still greater. Even a poplar tree is more than one-half water, while a ton of turnips contains only two hundred pounds of solid matter and eighteen hundred pounds of water. This water is taken into the plant through the roots, and in addition to forming such a large proportion of the weight, it serves as a carrier and solvent for the other ingredients.

The carbonic acid which exists in the air in the proportion of about one part by volume to every twenty-five hundred of air furnishes some additional oxygen and the whole of the carbon to the plant, and in this case the leaf is the medium of introduction. The ammonia and nitric acid, which are found in the free state in the atmosphere are washed down by the rain into the soil, and the supply being increased in the soil, they are taken into the plant by the root and an additional supply of oxygen and hydrogen and all of the nitrogen is furnished. These four substances, then, water, carbonic acid, nitric acid and ammonia exist both in the atmosphere and soil, and the two former being present in such quantity no additional mention of their properties is needed.

THE IMPORTANT INGREDIENTS.

When the plant is burned the oxygen, hydrogen, nitrogen and carbon are thrown back into the atmosphere in the combinations above mentioned, and a white ash remains behind. This ash contains the mineral elements of the plant, and although these elements form only a very small part of the whole, they are none the less important. This ash contains the silica, lime, magnesia, iron, potash, soda, phosphorus, sulphur and chlorine which are essential to plant life, and which, being in solution in the water, are taken in through the roots and become a part

of the general structure. Except the nitrogen, phosphoric acid and potash, of all the above constituents the soil generally contains sufficient, and if there be a deficiency in any one the same can usually be easily and cheaply supplied.

Therefore, says George E. Waring in his work on Agriculture, it is chiefly desirable for the farmer to give his attention to the sources from which the plant may derive its three important ingredients; for without them none of our cultivated plants will attain their full development, and when a soil ceases to produce good crops, it is almost always in consequence of a deficiency of one or more of them. The farmer raises no crop which does not contain them, he sells no animal or vegetable product which does not take them from his farm, and he has no soil so rich that they or some of them need not be returned to keep up its fertility Whatever course of cultivation he pursues he should never lose sight of these elements, and he should pay no greater heed to the dollars and cents he receives and pays out than to the *nitrogen*, *phosphoric acid* and *potash*, which constitute his real available capital, and whose increase and decrease mark the rise and fall of his true wealth. Such being the case, it is the business of the farmer to learn something of the nature of the soil which he cultivates, and if these necessary ingredients be not present in their proper state and proportion, then measures should be taken to supply what is needed.

DIFFERENT BRANDS OF FERTILIZERS.

Of the numerous brands of commercial fertilizers in the market, some contain one of these important ingredients, some two, and others all of them. Dissolved bone black and dissolved South Carolina rock contain phosphoric acid, but no nitrogen nor potash. The potash salts contain only potash, while nitrate of sodium, sulphate of ammonium and dried blood contain only nitrogen. The superphosphates, which comprise the bulk of the fertilizers in the market, contain phosphoric acid as well as potash and nitrogen, and these are made by mixing different substances which contain the ingredients mentioned. The nitrogen may be obtained from the sulphate of ammonium or nitrate of sodium or from some animal or vegetable product

which may furnish this element in an available form. Dried fish, blood, meat, fine ground bone, cotton seed, tankage, horn shavings and similar products are used for the purpose, and the commercial value of the nitrogen will vary with the material from which it is obtained, that from dried fish and blood being worth more than twice as much as that obtained from horn shavings, hair or fish-scrap.

The phosphoric acid is mostly obtained from bones and rock phosphates and the potash from the muriate, sulphate and kainite. The commercial value of the phosphoric acid and potash varies, too, with the products from which they are obtained, but the variation is not so marked as in the case of nitrogen. The superphosphate as well as the acid phosphate contains a considerable amount of sulphate of lime or gypsum, it being one of the products when the sulphuric acid is applied to the bones or rock phosphate. There may also be found some magnesia and perhaps some iron, silica, soda, chlorine and alumina, but they are not estimated in determining the value of the mixture. Sometimes also a filler is added, not for the purpose of defrauding any one, but for the purpose of increasing the bulk of the fertilizer, and, therefore, make it less concentrated and so cost less by the ton. It is now proposed to examine the source and properties of the various ingredients in turn, and thus learn something of the true nature and composition of the fertilizer.

THE SOURCES OF NITROGEN.

Nitrogen, as has been stated, is one of the organic constituents of the soil and plant, and the only one which it is necessary to add in the fertilizer. It exists in abundant quantities in the atmosphere, being about four-fifths of the whole. It surrounds the plant on every side, but, as free nitrogen, the plant is powerless to assimilate it. Tantalus in the midst of water could not even procure a drop to drink, and the plant, enveloped in an atmosphere of nitrogen, cannot take the trifle without which it cannot exist. It is a case of want, and often death; in the midst of plenty, but nature's laws are mysterious in their workings, yet always perfect when rightly interpreted.

The nitrogen is not only essential to every plant, but to every part of the plant. Root, stem, branch and leaf must

each have its proper share, and this must be derived through the root from its combinations in the soil. The ammonia and nitric acid in the atmosphere are washed down by the rain, and these with the humus in the soil are the natural sources of the nitrogen. The nitric acid, which is claimed to be the true source of this important element combines with mineral matters in the soil to form nitrates, but by far the larger quantity of nitrates are formed by the oxidation of ammonium compounds and the animal and vegetable matter.

The nitrification of the soil, or the manner in which the element gets into the plant, has long been an extremely difficult problem in scientific agriculture, but Pasteur and others have finally agreed that it is due to fermentation, something similar to that which is formed in yeast, and which requires some nitrogenous form to give the organisms life and vigor. Very little nitrogen is found in the average soil, and very little is taken up by the plant. It has been estimated that in 4,000,000 lbs. of arable soil, which is about the weight of an acre to the depth of one foot, 280 pounds of nitrogen in an assimilable form is sufficient to produce a maximum crop of wheat, while far less would be sufficient for rye and still less for oats. Not much then of this important element is needed for the plant, but the soil may easily be exhausted of the little it contains, and if this be not restored the plant will not grow.

Nitrogen is known to the fertilizer trade in three forms. It can be purchased as nitric acid in nitrate of sodium as ammonia in sulphate of ammonium, and as organic nitrogen, found in various animal and vegetable substances.

NITRATE OF SODIUM.

This is sometimes called Chili saltpetre, because it is found as an incrustation on the soil in Chili and elsewhere in South America. As met with in commerce the salt is not quite pure, but generally has about five per cent. of adulterations. When pure it contains 16.4 per cent. of nitrogen, and hence about 6½ pounds of the salt is necessary to furnish one pound of nitrogen. When applied to the soil it serves a double purpose in that it furnishes the nitrogen which is essential to the plant growth, and it stimulates the plant to collect the other materials

which are also necessary to its existence. Frequently twice and three times as much nitrogen is taken off in the crop as could be derived from the nitrate of sodium supplied, and this fact can only be explained on the ground that the plant is stimulated to unlock the comparatively inert soil nitrogen, and thus gain an additional supply of food. This same may be said of guano and sulphate of ammonium, and so efficacious are they in rendering the soil nitrogen available, that it has been suggested to supply in the fertilizer about half as much nitrogen as would be removed in the full crop.

SULPHATE OF AMMONIUM.

This is the only cheap salt of ammonium, and the only one within the reach of the agriculturist. It is prepared on a large scale in the manufacture of illuminating gas, and is also found native. When pure it contains 21.2 per cent nitrogen, but it is seldom found pure, and 5 pounds of the crude sulphate will generally furnish one pound of nitrogen. It has been estimated that the distillation of 100 tons of coal will furnish one ton of the sulphate or about 400 pounds of nitrogen, and nitrogen in ammonium salts has a somewhat greater commercial value than nitrogen in nitratés.

ORGANIC NITROGEN.

Substances containing nitrogen as organic matter may be animal in their origin, as dried blood, ground fish, flesh meal, bone, horn shavings, hair, wool waste, leather scrap, tankage and such like products, or vegetable, as rape cake, oil cake, soot, cotton seed meal and castor pomace. The value of the nitrogen in these various products varies at present from 17 cents per pound in fish, blood, cotton seed and castor pomace, to 8 cents in hair, horn shavings and coarse fish scrap. Most animal and vegetable substances being rich in nitrogen, most of these waste products can be utilized in the manufacture of fertilizers, and the value of such products is generally determined by their mechanical division, and by the readiness with which they give up the important element.

It is not possible for the farmer to determine what product is utilized in the particular fertilizer which he purchases, but he

may come near the truth by noting the locality in which the superphosphate is prepared. If it be prepared in the East fish-scrap or some chemical salt is probably used in the manufacture; if in the South cotton-seed meal is the product, and if in the North or West dried blood, tankage, bones and like products are the sources of the nitrogen. It is one of the triumphs of modern chemistry that products which a few years ago were considered worthless, and could not be disposed of without great expense, are now largely used in the manufacture of fertilizers, and serve an important purpose in furnishing the food-supply of the nation.

GUANO.

In addition to the nitrate of sodium, sulphate of ammonium and the organic products mentioned above, Peruvian guano may be classed among those substances which are capable of supplying ammonia or nitrates to the soil. Unlike most of the substances already mentioned, however, guano contains in addition to the nitrogen a considerable amount of phosphoric acid and potash, but the nitrogen being present in large quantities and being the most valuable ingredient, the substance may be fitly classed with those which give nitrogen to the plant. Peruvian guano is the best known of the artificial manures, and at the same time it is one of the richest and longest in use. When it was first imported into Europe, about half a century ago, it was very rich in organic matter containing nitrogen and also in ammonium salts. An average analysis made only twenty-five years ago by Dr. Voelcker showed nearly 19 per cent. of ammonia, but the guano of to-day will scarcely average one-half of that amount. The falling off in the quality of the material is probably due to the rapid exhaustion of the beds, and at present there is not a great deal of the genuine article in the market. The guanos whose analyses are found so frequently in the agricultural reports are mostly guanos only in name, they being artificial manures prepared like the superphosphates. During the last season in Georgia no less than 32 brands of so-called guano were exposed for sale, and no one of these contained as high as 3 per cent. of nitrogen.

The enuine guano consists of the accumulated refuse of sea

fowls, and is found on certain islands off the cost of Peru. This refuse has lain undisturbed for many centuries, and besides the ammonium salts, it contains a great deal of uric, oxalic and phosphoric acids. For the accumulation and preservation of the guano, certain natural conditions seemed to have been necessary, among the more important of which were an extreme abundance of fish food, an almost entire absence of rain and a limited area to serve as a resting and brooding spot for the birds. So important was the second of these conditions that in regions where the rain fell the guanos are called phosphatic guanos, the soluble and nitrogenous matters having been lagely washed out by the water, the less soluble and phosphatic matter alone remaining. This is the condition of the Baker, Jarvis and Howland guanos, and these products are scarcely worth one-half as much as those which come from rainless regions. The modes of applying the nitrogenous manures, and the crops most benefited by their application, will be considêred in a subsequent section of this paper.

SOURCES OF PHOSPHORIC ACID.

It is generally conceded that when any soil has been exhausted by improper farming in nine cases out of ten it is the phosphoric acid that is gone. Not that the total amount of this essential ingredient has been removed from the soil, for the analysis of a fertile soil would show within a foot of the surface an amount of phosphoric acid sufficient for one hundred crops, but the improper farming has gathered up every atom that is available, and left only that which is in the insoluble state. The actual loss of nitrogen from the soil is at no time great. This being an element which exists in every part of the plant—root, stem, grain and leaf, much of it finally gets back into the atmosphere and thence into the soil by natural means, and becomes again available to plant life. Potash, too, existing in larger quanties in the soil, and being produced by the decomposition of felspar and other rocks is a somewhat permanent constituent of the soil, and its absence is only felt after many seasons of continuous cropping.

With phosphoric acid, however, the case is very different. In the early growth of the plant, being found in the young

organs, especially in the leaves, in the later stages of growth it has accumulated largely in the seeds and fruit, and these being sold off the land, the soil is robbed of its most valuable ingredient. Being a fixed ingredient, it is not returned by the wind or rain, and its loss can only be made good by the use of the fertilizer. Nor is there much phosphoric acid in the soil as compared with the other ingredients. Even in the most fertile soils seldom is one per cent. found, while the average quantity is less than one-half of that amount. "A clay loam soil," says Lloyd, "six inches deep and covering an acre of ground is estimated to weigh one thousand tons. If this soil contains two-tenths of one per cent. of phosphoric acid there will be about 5,000 pounds to the acre. But should a soil of peaty nature weigh only 500 tons to the acre, then there will be only one-half as much phosphoric acid as before. Of the mineral part of a grain of wheat nearly one-half is phosphoric acid, in rye the proportion is not much less, and in corn it is a trifle more, while in the ash of the other grains and in other vegetable products it is also abundant.

Playing such an important part in both animal and vegetable life, it is well worth the farmer's while to inquire into its properties, and source, and to see to it that it exists in proper quantity and form in the soil on his farm. In the soil it exists in combination with lime, magnesia, iron and alumina, forming neutral phosphates with these elements. Most commonly it is found in combination with lime. These compounds being largely insoluble in water, as the tendency in the soil is always that the phosphate of lime shall be changed to the even more insoluble phosphate of iron, there is practically no loss by drainage, and the only outgo is that occasioned by the removal of crops. Being so scarce in the soil, and at the same time being so essential to plant life, it is not strange that it has been sometimes called "the chemical" of agriculture, and that it is regarded the most important ingredient of the commercial fertilizer.

PHOSPHORIC ACID IN BONES.

The phosphoric acid in fertilizers is derived mostly from bones, guano and phosphate rock. Lately the slag obtained in the

working of crude iron has come to be recognized in Germany as a valuable source of this ingredient, and thousands of tons of this seemingly worthless product are now yearly ground to powder and utilized for the phosphoric acid they contain. Bones are used as bone meal, bone ash and bone black. Bone meal is obtained by grinding the crude bones to fine powder, and is valuable not only for the phosphoric acid which it contains, but also for its nitrogen. Bones when thoroughly dried consist of about two-thirds earthly matter, and one-third organic or combustible matter. The bones are most easily ground after being steamed, and while this process occasions a loss of nitrogen in the separation of a part of the organic matter, yet the meal is much finer in texture, and of greater value in agriculture.

The mechanical condition of bones when applied as a fertilizer is a matter of very great importance. The finer the division the sooner will all of the phosphoric acid become available as food for the plant, and the sooner will the farmer reap the returns from the money expended in the fertilizer. The theory that those manures which make themselves felt over the greatest number of years are the most valuable has long since been questioned, and it is generally conceded that those are to be preferred which will give the maximum return in the shortest possible period. Food prepared for man or animals grows less nourishing and valuable the longer it is unused, and food prepared for the plant should be given in such a condition that it may not remain unconsumed. Food may spoil in the soil, just as food may spoil in the pantry or barn, and a little food given often is vastly preferable to an excess given seldom. So thoroughly has this belief been adopted by agriculturists that by patent pulverizing machinery bone flour has been made of such extraordinary fineness that it floated in the air, and while this product would be quick in its action, it was found that it could not be used, as the least wind would blow it from the field.

Bone meal is sometimes classed as fine, medium and coarse, the former being about one-third more valuable than the latter. The meal is often adulterated with gypsum or salt cake, which

has been added to the bone as a preservative or drier, and sometimes mixed with it coal ashes, ground oyster shells, lime and similar products are found. The demand for bone meal in the arts, and especially in sugar refining, may ultimately take this valuable fertilizer from the market, and the superphosphate of the furture will be made more likely from rock phosphate or bone black.

BONE ASH AND BONE BLACK.

When the bone is subjected to a strong heat, the organic matter referred to is driven off, and the earthy matter, which contains the phosphoric acid, remains as the ash. As the nitrogen in the bone meal is given by the animal matter, or ossein' as it is called, this important fertilizing element is not found in the bone ash. The supply of this substance is obtained chiefly from South America, where stock raising is one of the chief industries of the people, and where bones are used as fuel in the process of extracting the fat from the slaughtered cattle. After the burning this ash is collected and sacked, and being light and compact it is easily handled.

When broken bones are subjected to a strong heat in an iron cylinder without access of air, water, tarry and oily matter and other products are driven off, and a porous residue is left in the cylinder. This residue is of great value for removing coloring matter from liquids, and is largely used by sugar-refiners in purifying brown sugar and other colored substances. After it has served its purpose in this respect, it is still valuable to the agriculturist, as it contains most of the phosphoric acid the fresh bone contained. Being open and porous, this residue is in a finely divided state, but being practically non-nitrogenous, it is less valuable than bone-meal. The different varieties of bone fertilizers may be applied directly to the soil, and excellent results will follow the application, but ordinarily they are treated with sulphuric acid, and the phosphoric acid is then obtained in a more soluble form.

MINERAL PHOSPHATES.

While the importance of ground bones as a source of phosphoric acid has long been recognized, it is only in recent years

that the immense trade in mineral phosphates has been built up. The term "South Carolina rock" has become a by-word in scientific agriculture during the past decade, and the bulk of the phosphates in the markets are made from this valuable material. The mineral phosphates are found chiefly as apatites or crystalline phosphates, as phosphorites or amorphous phosphates and as coprolites or fossilized nodules. The apatites are found in veins of volcanic and crystalline rocks both in Europe and America, and are supposed to have been of concretionary origin, having been deposited out of solution in warm saline springs. The coprolites are traced to animal life, are generally from two to four inches in length, from one to two inches in diameter, from gray to black in color and in the shape of a kidney. They are found in the green sand-stone or cretaceous rocks of England, France, Belgium and Russia. The phosphorites occur largely in Spain, Portugal, Bavaria and elsewhere in Europe, and in this country in South Carolina.

SOUTH CAROLINA ROCK.

The bulk of mineral phosphates used in this country come from South Carolina, in which State, according to Prof. Holmes, the phosphatic deposits underlie no less than 250,000 acres, though the accessible deposits comprise an area not one-tenth as great. The phosphatic deposit extends from the head-waters of the Wando river, in a line parellel with the coast and at a distance from it of from ten to forty miles to the head-waters of the Broad river. This is the territory of active operations, but the entire formation is said to extend into North Carolina on the north and Florida on the south, and it has been observed in the interior a distance of sixty miles from the coast. As this rock plays such an important part in the fertilizer trade of the country, the following description of its properties is condensed from Charles U. Shepard's report to the Commissioner of Agriculture of South Carolina:

The most prominent characteristic of the Carolina phosphate is its nodular form. Even where the deposit occurs as an apparently smooth and compact floor, or in large flat cakes, it is, nevertheless, composed of irregular nodules, partially cemented or tightly compacted together. The shape of the nodules is

egg or kidney form. The exterior is rough and indented, often perforated or even honey-combed by round or irregular holes and cavities, or it is smooth and compact. The surface is occasionally shiny and coated, as it were, with enamel. The masses are wholly devoid of crystalline structure or cleavage, exhibiting occasionally, however. an imperfect lamination. Well preserved casts of eocene shells occur throughout the phosphatic rock, and fossil fish bones and teeth are not infrequently found imbedded in them. The nodules vary in size from a fraction of an inch to several feet in diameter; in weight from almost a ton downwards. The color of the land rock is generally lighter than that found under water or marsh mud, the former having a yellowish or grayish white color, the latter a grayish or bluish black. The masses are easily powdered, and the dust is very fine. The rock gives on friction of its fresh surfaces a peculiar fetid odor, termed by some napthous. This property is the more decided the denser the structure and the higher the content of organic matter. The analyses of the rock vary somewhat, but the average of several hundred show from 25 to 28 per cent. of phosphoric acid, from 35 to 42 of lime, from 4 to 12 of sand and silica, from 2 to 6 of organic matter and combined water, and the remainder consisting of small amounts of sulphuric acid, carbonic acid, magnesia, alumina, sesquioxide of iron, fluorine, sodium and chlorine. The organic matter occasionally yields as high as a quarter per cent. of nitrogen.

Professor F. S. Holmes explains the formation as detached masses of eocene marl, torn off by the action of waves from the great mass of this formation, and swept inland over the sand-bars, which, as also the great marl bed, were covered by the waters of the ocean, to be deposited in those shallow bays and salt water lakes that are now the phosphatic region of South Carolina. Prof. Shepard regards the deeper strata of phosphatic masses as the result of a concentration by carbonic acid of the phosphates sparsely distributed through the overlying marls.

The use of the South Carolina rock in the manufacture of the bulk of commercial fertilizers may be accounted for as follows: It is cheap. It is remarkably free from impurities. It is

readily ground. It is readily acted upon by sulphuric acid. The superphosphate made from it dries readily, is light, and may be easily made to contain the amount of soluble phosphoric acid that is required in fertilizers. Its constituents are assimilated by plants more rapidly and effectually than occurs with most other mineral phosphates. Added to these the supply of the rock is extensive, and the source is convenient to the commercial centers.

SLAG FROM CRUDE IRON.

In addition to the bone meal, bone ash, bone black, guano and South Carolina rock already described, a new product has within a year or two made its appearance in the market as a source of phosphoric acid, and bids fair to play an important part in the manufacture of fertilizers in the future. As is well known, pig iron contains a considerable amount of phosphorus, which must be gotten rid of when the iron is converted into steel or forged. The slag obtained in ridding the iron of the phosphorus has been named Thomas slag, and contains the phosphorus originally in the iron. The iron being removed, the slag is broken up, ground and used as a fertilizer. Consul Smith in writing from Mayence, Germany, to the authorities at Washington, states that this product is made up of about 16 per cent. of phosphoric acid, 50 per cent. of lime, 12 per cent. of oligist iron and oxidized iron, and 7 per cent. of silicic acid; but the phosphoric acid can run from 10 to 25 per cent. Under the name of patent phosphate meal, a dust, meal or flour is given to the public made out of manipulated Thomas slag, which contains from 24 to 28 per cent. of phosphoric acid.

It was thought that this substance could not be used as a fertilizer, as it would not dissolve easily enough to make the phosphoric acid available, but experiments have shown that it is only necessary to reduce the slag to a powder to make a fertilizer as effective as bone dust or guano. The German iron works, says Consul Smith, make about 400,000 tons of Thomas slag a year, which can be sold to the farmers, when reduced to a dust, at a price about one-third that of a superphosphate containing an equal amount of phosphoric acid. Professor Wagner, who has experimented largely with this material, claims

that the form in which the phosphoric acid is contained in Thomas slag is far more decomposable, and much more easily taken up by plants and more easily dissolved by acids and water than the phosphoric acid contained in mineral phosphates. The iron is said to have no prejudicial influence upon plants, and on a wheat soil the slag acts more quickly than the ordinary fertilizer. It is especially recommended for meadow and marsh lands, and in vineyards, orchards and gardens it provides a good soil for the plants to strike their roots into for life and moisture.

THE NATURE OF A SUPERPHOSPHATE.

Following the description of those substances which furnish phosphoric acid to the fertilizer, the use of sulphuric acid in agriculture may be explained. This acid is commonly known as the oil of vitriol, and is a thick oily liquid with a specific gravity nearly twice as great as that of water. It is the most useful acid known, as by its means many of the other acids are prepared, and so important is it in the arts and manufactures that it has been said that the commercial prosperity of a country may be indicated by the amount of sulphuric acid it consumes. When bone meal, bone ash, bone black or phosphatic rock is applied to the soil, the phosphoric acid which they contain is largely insoluble in water, and the maximum results from their application may not for some time be obtained. Especially is this true of the phosphatic rock, the insoluble phosphoric acid having a less value than that contained in bone, and from the application of this rock in the raw state very meager results would be obtained. It was Baron Liebig who first suggested that if the bones or mineral phosphates be treated with sulphuric acid, a chemical change would take place by which the insoluble phosphoric acid would be changed to the soluble form, and a considerable amount of gypsum would also be obtained.

This change may be more readily understood when it is stated that the tri-calcic-phosphate of lime as found in the raw bone or rock, is made up of one equivalent of phosphoric acid and three equivalents of lime. When sulphuric acid is added to the rock or bone, two equivalents of lime enter into combination with the acid, and the remaining compound

has now only one equivalent of lime to one equivalent of phosphoric acid, with some water added which is given up by the acid. Thus a substance is obtained which is richer in phosphoric acid than before the treatment with sulphuric acid, and what is far more to the point this new substance is in a much more finely divided state, and the phosphoric acid is now almost completely soluble in water. These points being gained, the substance may now be applied as a fertilizer, and from their application far better results than from the raw bone or rock will be obtained.

The difference in the size of the particles of the finest bone dust before being treated with the acid and afterwards has been carefully ascertained. According to the measurements of Prof. O. N. Rood, of Troy, by the use of the microscope, the smallest particles of bone dust would not average less than 1-100 of an inch in diameter, while the same particles after being so treated with the acid, and so changed to the superphosphate, would measure only 1-23,000 of an inch in diameter. What is commonly known as dissolved bone to the fertilizer trade is bone treated with sulphuric acid, and an acid phosphate is generally rock treated in the same manner. Common usage has restricted the term acid phosphate to the fertilizers containing only phosphoric acid, while the superphosphate is the same with the addition of substances containing potash and nitrogen. In some States, however, the term acid phosphate is applied to fertilizers which contain less than 10 per cent. of available phosphoric acid and less than 2 per cent. of ammonia, while ammoniated superphosphates contain more than 8 per cent. of available phosphoric acid and more than 2 per cent. of ammonia. The names of the various brands are subject to the whims of the manufacturers.

THE SOURCES OF POTASH.

In former years wood ashes were the only available source of potash. They contained on the average about 4 pounds of the potashes to 48 pounds or a bushel of the ashes, and when transportation to a distance was not necessary they served their purpose well. When the forests began to be exhausted, and coal came generally into use, the supply of ashes was largely de-

creased, and the discovery of some other potash fertilizer was anxiously awaited. This discovery was made about thirty years ago in Germany, when a large deposit of potash salts was opened up near Stassfurt, and now these salts are so cheap that they may be utilized to advantage on every farm. The lower stratum of this vast deposit consists of a bed of salt of unknown depth. Above this salt is another bed of salt and potash minerals, with which is mixed some soda, magnesia and lime, the whole being about 250 feet in thickness. The supply seems to be almost inexhaustible, and the cost of extracting the mineral is so little that the cost of potash as reckoned in the average fertilizer is scarcely more than one-half as great as that of the soluble phosphoric acid, and not one-third as great as that of the nitrogen.

Most of the potash in the soil comes from the decomposition of feldspar, and some from mica and other minerals. When the feldspar is decomposed a clay soil is formed, and as this decomposition goes on slowly a supply of potash is being continually furnished. E. M. Pendleton, of Georgia, gives a table of the analyses of 101 American and 28 English soils, and the average amount of potash in each is a trifle more than seven-tenths of one per cent. The strong clay soil will contain a very much higher percentage, and the light sandy soil a very much lower. The clay soil is strong, because it has enduring fertility, and it has the fertility largely in consequence of having the potash.

The potash is in the soil in the form of double silicates, and hence not easily washed out. The only loss is from the removal of crops. Nor does it accumulate in fruits and seeds as phosphoric acid, but being in the hay, fodder and stalks it largely remains on the farm. When sugar beets, tobacco, carrots, turnips, onions, clover, hops, beans, peas or potatoes are raised in quantity, and sent to the market, a great deal of potash is sold in these products, and if the soil be sandy the loss must be made good. An average crop of wheat will remove about 25 pounds of potash to the acre, an average crop of potatoes four times as much, and an average crop of tobacco twice as much as the potatoes. In addition to the wood ashes, and the American potashes which are made from the ashes and the sulphrates and chlorides which come from Germany, as a

source of potash green sand marl is used in New Jersey, and the ashes of cotton seed hulls in some parts of the south. On the average farm the supply of potash is not likely to be so soon exhausted as that of phosphoric acid or nitrogen.

MODES OF APPLYING ARTIFICIAL FERTILIZERS.

The following directions for the application of fertilizers, and the crops best suited for each are condenced from Storer's recent work on Agriculture. What needs to be done in order to secure their proper diffusion and distribution in the soil can now be said. For example, superphosphate, nitrate of sodium and even sulphate of ammonium may be merely scattered on the surface of the land, since they will soak into the soil readily enough. Bone meal, oil cake and fish scrap, need only be buried deeply enough, in not too dry earth, that they may nitrify readily. Bone ash, bone black and phosphatic guano need to be buried pretty deeply, and well commingled with the soil. With them, as with potash salts, it would be well, were it not for the trouble involved, to apply one portion of the dressing before ploughing the land, another before cross-ploughing it, and another before harrowing, to insure thorough distribution.

In Germany potash salts are particularly commended for beets, potatoes, clover, cabbages and hops—all leafy plants it will be noticed. But it is upon clover especially and other leguminous plants that potassic manures show the most remarkable effects. Messrs. Lawes and Gilbert in experiments with a variety of different plants, continued through long terms of years, found the potassic manures more useful with clover, beans and peas than with any other crops. Dr. Gilbert has recently summed up his experience in the following terms: It is found, he says, that easily assimilable nitrogenous manures have generally a very striking effect in increasing the growth of grain crops, such as wheat, barley and oats; although these grain crops contain comparatively little nitrogen, and take but little of it from the land. The leguminous crops, on the other hand, such as peas, beans, clover and others, although highly nitrogenized, are by no means characteristically benefited by the use of direct nitrogenous manures, such as ammonium salts

and nitrates, though nitrates act much more favorably than ammonia salts. It appears, indeed, that we may say, "Use phosphates for turnips and such like roots, potash for leguminous plants and active nitrogen for grain.

THE FERTILIZER ANALYSIS EXPLAINED.

In West Virginia the law requires that the analysis of the fertilizer shall be printed on every sack. It has frequently been stated, and with a great deal of truth, that the farmer does not understand the terms that are used, and is, therefore, not in a position to select that fertilizer which his particular crop or soil may need. The nature of the various ingredients of which the fertilizers are composed have already been fully described, and it only remains to explain the terms which are found on every sack. The moisture is generally the first determination given, and this mostly varies between 9 and 15 per cent. A fertilizer which contains 12 per cent. of moisture contains 12 pounds of water in ever 100 pounds of the fertilizer or 240 pounds of water in every ton. This moisture should be taken into account in estimating the value of the product, as every pound of water adds so much to the cost of transportation. This moisture is subject to variations with the climate and condition of the atmosphere, and in the case of a second analysis a considerable discrepancy may be noticed. The chemist in making an analysis of an acid phosphate will use scarcely more than a spoonful of the mixture, and as this amount is accurately weighed, a variation in the moisture will produce a variation in the phosphoric acid. The variation in two analyses may be slight, but when the amount is computed in a hundred tons of the fertilizer the variation becomes important.

The soluble phosphoric acid means the phosphoric acid that is soluble in pure cold water, and this is the most valuable form of the acid that is found in the fertilizer. This is made soluble, as before explained, by treating the bones or mineral phosphates with sulphuric acid, and when applied to the soil it becomes immediately available for plant-life. Being thoroughly distributed throughout the soil, it may become insoluble after it has soaked into the earth, but before this has happened the mechanical distribution has been completed.

The reverted phosphoric acid means that which is insoluble in pure cold water, but is soluble in a neutral solution of citrate of ammonium under the standard conditions. This form of the acid was originally soluble in pure cold water, but from the reaction of the iron and alumina it has partly gone back or reverted. Another explanation of its presence is given in the statement that when not enough sulphuric acid has been used in the manufacture, it is claimed that the insoluble phosphate which has not been decomposed reacts upon the soluble and changes a part of it to the reverted form. In most of the States the reverted phosphoric acid has nearly the same commercial value as the soluble, for when applied to the soil, like the soluble, it soon becomes available for plant-life.

The insoluble phosphoric acid means that which is neither soluble in pure cold water, nor in the solution of citrate of ammonium, but is soluble in the stronger acids. This is the form in which it exists in nature in the bone or phosphatic rock, and its commercial value is largely determined by the source from which it is derived. In general, the bone products dissolve more readily than the rocks, though appreciable quantities of the latter will in time dissolve in the soil by the action of the humic acid, carbonic acid, saline solutions and plant-roots. The phosphoric acid in dry fine ground fish and in fine bone and tankage is almost as valuable as that soluble in water; and in medium and coarse bone the value is still less. In fine ground mineral phosphate the value is about one-fourth that of the acid soluble in water, but in many States the insoluble acid of the superphosphate is given no value whatever.

The available phosphoric acid is the sum of the soluble and reverted, and the total is the sum of the insoluble and available. If the fertilizer be an acid phosphate, only the above determinations will be found on the sack, except in some States as before stated; if it be an acid phosphate with potash, then the potash percentage will also be found, and if it be one of the many varieties of ammoniated superphosphates, then to the phosphoric acid determinations will be added those of potash and nitrogen. The potash is generally reckoned as the oxide of potassium, and if obtained from the high grade sulphate it is commercially

worth about one cent more per pound than if obtained from kainite or the muriate. The commercial value of the potash from these latter sources is a trifle more than one-half as much as that of the phosphoric acid soluble in water and about one-fourth as much as nitrogen in its best forms. The nitrogen is sometimes reckoned as such and sometimes as ammonia. If reckoned as ammonia the actual nitrogen may be obtained by dividing the percentage by 17 and then multiplying the result by 14. This is by far the most expensive element in the fertilizer.

FERTILIZER CALCULATIONS.

The terms found on every sack having now been explained, the farmer may easily determine how many pounds of each ingredient will be obtained in every ton of the fertilizer. If the analysis, for example, shows 10 per cent. of available phosporic acid, 2 per cent. of insoluble, 3 per cent. of potash and 2 per cent. of nitrogen, then in every one hundred pounds of the fertilizer are 10 pounds of the available acid, 2 of the insoluble, 3 of potash and 2 of nitrogen, and in every ton are 200 pounds of the first ingredient, 40 of the second, 60 of the third and 40 of the fourth. If the farmer wishes to go a step further, and in addition to finding the number of pounds of each ingredient to the ton, he wishes to estimate the commercial value of each ton of the fertilizer, he may do so with little trouble and expense, and, therefore, be able to tell whether he is asked a just price for the fertilizer which is offered to him for sale. Before attempting this calculation he must first ascertain the trade values of the various ingredients contained in the fertilizer, and he must also judge approximately of the source of these in the mixture. At the beginning of every fertilizer year these trade values are made up by several of the Experiment Stations of the East, and are the prices at which the raw materials and chemicals can be purchased in the eastern markets. To these may be added from three to four dollars per ton, which the manufacturers claim is the cost of mixing, handling and cartage, and also the cost of transportation. These trade values for the years 1887 and 1888 are given in the following table, and they will be ascertained hereafter every year by the West Virginia Experiment Station.

TRADE VALUES OF FERTILIZING INGREDIENTS IN RAW MATERIALS AND CHEMICALS FOR 1888.

	1887. cts. per lb.	1888. cts. per lb.
Nitrogen in ammonia salts	17½	17½
" in nitrates	16	16
Organic nitrogen in dried and fine ground fish	17½	16½
" " in blood, meat, cotton seed, and castor pomace	17½	16½
" " in fine ground bone and tankage	16	16½
" " in fine medium bone and tankage	14	13
" " in medium bone and tankage	12	10½
" " in coarse bone " "	10	8½
" " in horn shavings, hair and fish scrap	8	8
Phosphoric acid soluble in water	8	8
" " " in ammonium citrate	7½	7½
" " in dry fine ground fish and in fine bone and tankage	7	7
" " in fine medium bone and tankage	6	6
" " in medium bone and tankage	5	5
" " in coarse bone and tankage	4	4
" " in fine ground rock phosphate	2	2
Potash as high grade sulphate	5½	5½
" " kainite	4¼	4¼
" " muriate	4¼	4¼

If now the nitrogen is in the best form in the fertilizer it may be rated in general at 17 cents a pound, the available phosphoric acid at 8, the insoluble at 3, and the potash at 4½. This will probably be near enough the truth to enable the farmer to get at the approximate value of the fertilizer. If, now, in the example above given, the fertilizer contain 200 lbs. of available phosphoric acid, 40 of the insoluble, 60 of the potash and 40 of the nitrogen to the ton, then the value of the first ingredient is $16, of the second $1.20, of the third $2.70 and of the fourth $6.80, making the fertilizer worth $26.70 per ton. Supposing the fertilizer to be as represented, and this is generally the case with all of the standard brands, and taking some minor consid-

erations into account, as agents' fees, losses from bad debts, the question of cash or credit, the farmer is now in a position to judge whether a fair price is asked for the product which is offered to him for sale.

COMMERCIAL VALUE NOT NECESSARILY THE AGRICULTURAL.

In this connection the farmer must not suppose that the commercial value of the fertilizer necessarily represents the agricultural value on his particular soil or farm. The two values may have very diff rent meanings on different farms, and the latter can only be determined by taking into account the character of the soil and the kind of crop that is to be raised. If a soil be simply deficient in phosphoric acid but with sufficient nitrogen and potash for present needs, then an acid phosphate costing $20 per ton may give as good results for the present as a high priced ammoniated superphosphate costing double that sum. In the one case that ingredient is purchased, which the soil immediately needs, while in the other potash and costly nitrogen are also purchased for which the soil stands in no immediate need. In eastern Pennsylvania where there is a deficiency of phosphoric acid in the soil, acid phosphates are used year after year to good advantage, while in the Connecticut valley and in the worn-out tobacco regions of the South potash is the element to be especially looked after in the fertilizer.

In using a special fertilizer, however, great care must be exercised. It must never be forgotten that such a manure is supplying one essential ingredient in abundance to the soil, while the crop is removing the two others as well. "Special fertilizers," says a prominent writer, "require great care in their use, and as sometimes used it would often be more just for the tenant to give the landlord compensation for having deteriorated his land." During a few years in Maryland the yield of wheat was very largely increased by the use of guano, but it was found that this increase was not a lasting one, and after a time this highly nitrogenized fertilizer seemed powerless. The same has been noted of acid phosphates and potash salts in other sections, and the explanation lies in the fact that while

one essential ingredient is added the other two are left entirely out of the calculation. An acid phosphate should not be purchased simply because it is cheap, but because the farmer is satisfied that his soil needs only phosphoric acid. In this connection a quotation from Scott and Morton's "Soil of the Farm" will be of general interest.

A general fertilizer, say these writers, contains all the constituents of the crop, or at least all those in which soils are most deficient; but it by no means follows that every substance which may act beneficially ought to be applied. If a soil is deficient in one particular element, and contains all the other requisites of fertility, that one substance may act as beneficially when applied as though it contained all the constituents of the crop. The crop in this case is thrown upon the natural resources of the soil for all its other elements. By persisting in the use of a special fertilizer, an ultimate exhaustion of the soil is inevitable. Judiciously used special fertilizers are the agents which bring into useful activity the dormant resources of the soil; they restore the proper balance between its principal constituents, and supply the excessive demand for some particular elements. Still the application useful on one soil may be quite useless on another.

In summing up the results of the foregoing observations it is evident that the farmer who wishes to use commercial fertilizers intelligently, must not only make himself familiar with the character of their ingredients, but also with the nature of the soils upon which they are to be used, and the crops which are to be grown. He must remember in addition that the resources of nature may be readily exhausted, and that when the soil has become barren from injudicious cropping, the ingredients that are wanting must be returned in their proper form and proportion. The advance in scientific study in recent years has been marvelous, indeed, and nowhere has this advance been more strikingly felt than on the farm. New and improved machines have been introduced, artificial foods have been prepared, and improved stock and crops have been raised. In the use of commercial fertilizers has this knowledge been

especially valuable, and the different operations in connection with agriculture are now carried out on scientific principles. When these principles are more widely disseminated, and the nature of the different soils and crops are better understood, then will the food supply for plants and animals be more readily obtained, and the methods of scientific agriculture will everywhere be adopted.

BULLETIN NO. 3.

OF THE

WEST VIRGINIA

Agricultural Experiment Station

AT

ANTOWN, W. VA.,

ECEMBER, 1888.

Prepared under the Auspices of the West Virginia Agricultural Experiment Station.

BY WM. D. DOAN.

JOHN A. MYERS, Director.

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LETTER OF TRANSMITTAL.

PROF. JOHN A. MYERS,

Director West Virginia Agr. Exp't Station,

Morgantown, W. Va.:

IR:—I herewith transmit my report on the Birds of West ginia, including notes on their food-habits, on which, as are aware, I have been engaged since August 1. I ared at Buckhannon, Upshur County, on the above date began field work the following day. The work was caron in that vicinity for several days, during which time ade short excursions down the Buckhannon River for ten welve miles. August 19 I went to Braxton Court House; ice to Gauley Mountains; thence to Rich Mountains and the headwaters of Middle Fork and Buckhannon Rivers, and down the last named river, and arrived at Buckhannon September 7. Leaving for Weston the following day, I visited Fairmont, remaining there until Sept. 24. From thence my route was to Wheeling and down the Ohio River to Parkersburg, at which place I remained until the evening of October 10, when I proceeded to Lewisburg, Greenbrier County, making short stops at Point Pleasant and Charleston. From Lewisburg I worked my way up the Alleghanies to Patterson Creek, and on to Green Springs and Romney, Hampshire County, at which point my field work ended.

During the last five weeks in the field the inclemency of the weather was such that it was impossible for me to do any collecting whatever; and as the season was far advanced

and the remaining time short, my explorations were necessarily hurried. Much valuable time was lost in traveling in order to reach all the different districts, many of which are widely separated and remote from railroads. By far the most productive and satisfactory work was done at Buckhannon and vicinity during the month of August. The following list contains all species that I personally identified, together with a few additions from Mr. William Brewster's paper on the "Birds of Ritchie County, and W. E. D. Scott's "Birds of Kanawha County." It is far from complete, but may be considered a starting point for future investigations.

I wish to acknowledge my indebtedness to Dr. J. R. Mathers and Mr. E. L. Day, of Buckhannon, for valuable notes on several species with which I did not meet.

I am, sir, very respectfully,

WM. D. DO

Nov. 30, 1888.

BIRDS OF WEST VIRGINIA.

BY WM. D. DOAN.

HOLBŒLL'S GREBE.

Colymbus holbœllii (Reinh.).

ısient visitant: rare. A few are seen occasionally on the ınd Great Kanawha Rivers. I observed a single indi- September 28, while going down the Ohio River. Dr. ·rs informed me that he shot a specimen on Buckhannon in November, 1884.

HORNED GREBE.

Colymbus auritus Linn.

Transient visitant; rare. More frequently met with along the larger streams than the preceding species.

3. PIED-BILLED GREBE.

Podilymbus podiceps (Linn.).

Transient visitant; common; frequenting streams. Known under various local names, such as Dabchick, Hell-diver, Chicken-billed Duck, and Die Dipper. I found this Grebe August 28, on the head-waters of Buckhannon River, but did not meet with it again until September 13, while on my way down the Monongahela River. I am led to believe that it breeds on some of the mountain streams. A month later I met with it frequently along the Great Kanawha River. Of the three species of Grebes that visit West Virginia this is the most

common, and may be found on all rivers and ponds durig then spring and fall months.

4. LOON

Urinator imber (Gunn.).

Transient visitant. Tolerably common on the Ohio and Great Kanawha. It has been taken frequently on Buckhannon, Cheat, Monongahela, and South Branch of the Potomac Rivers. I obse ved a single individual on Greenbrier River October 15.

5. HERRING-GULL.

Larus argentatus smithsonianus (Coues.)

Accidental in spring. Dr. Mathers has observed it that season.

6. MERGANSER SHELLDRAKE.

Merganser americanus (Cass.).

Transient visitant; tolerably common. This species is throughout the State as Fish Duck. I observed it fre along the different streams after September 20. This a following Mergansers feed mainly, if not wholly, on fis

7. RED-BREASTED MERGANSER.

Merganser serrator (Linn.).

Like the preceding, this species is also known as Fish Duck. It occurs occasionally as a transient visitant.

8. HOODED MERGANSER.

Lophodytes cucullatus (Linn.).

Transient visitant; rare. Mr. Brown, of Parkersburg, has a stuffed specimen of this Merganser, which he procured on the Ohio several years ago. He has observed it occasionally since in fall and early spring. The Hooded seems to be the rarest of the three Mergansers that frequent the country visited, and the Shelldrake the most abundant. W. E. D. Scott took a specimen of this Merganser August 9, 1872, on the great Kanawha River. It was an immature female.

9. MALLARD.

Anas boschas Linn.

Transient visitant; common. This duck is sometimes known by the name of Green-head. I met with it during the last week of October along the South Branch of the Potomac, in Hampshire County.

10. BLACK DUCK.

Anas obscura Gmel.

Transient visitant; common on the Ohio River, where I met with it frequently after October 1, as well as on several of the smaller streams, where it is known as the Dusky Duck.

11. GADWALL.

Anas strepera Linn.

:ansient visitant; tolerably common on all the larger ams. It is generally known as the Gray Duck.

12. WIDGEON.

Anas americana Gmel.

Transient visitant. I did not observe any until November 3, d then one only, which was taken on the Potomac River, :ar Green Springs, Hampshire County.

13. GREEN-WINGED TEAL.

Anas carolinensis Gmel.

Transient visitant; tolerably common. Dr. Mathers informed me that this Teal is very common some seasons on Buckhannon River. I did not see it until descending Cheat River on the morning of October 22.

14. BLUE-WINGED TEAL.

Anas discors Linn.

Transient visitant; rare.

15. SHOVELLER.

Spatula clypeata (Linn.).

Transient visit; tolerably common.

16. PINTAIL.

Dafila acuta (Linn.).

Transient visitant; tolerably common.

17. WOOD DUCK.

Aix sponsa (Linn.).

Summer resident; common. Often called Summer Duck. It is considered the most beautiful of the many species of the Duck family that frequent the State, and is well known from the brilliant metallic coloring of its plumage. I found it more common on Buckhannon and Middle Fork Rivers than in any other portion of the State. In the autumn it feeds largely upon acorns, beech nuts, and elder berries.

18. RED HEAD.

Aythya americana (Eyt.).

Transient visitant. This duck is tolerably common Ohio River in later fall, and is occasionally met with on in the interior. I observed it on Greenbrier River Oct

19. CANVAS-BACK.

Aythya vallisneria (Wils.).

Transient visitant; tolerably common. The Canvas-sometimes mistaken by sportsmen for the Red-head. [illegible] occasions I observed stuffed specimens of it labeled "Red-head." In the Canvas-back nearly the whole head is reddish-brown, obscured with dusky about the bill, and the entire bill is dusky. In the Red-head the head is clear chestnut-red, with a bronzy reflection, and the bill is clear, pale grayish-blue, with a black tip.

20. GREATER SCAUP DUCK.

Aythya marila nearctica Stejn.

Transient visitant; rare. Occurs occasionally on the Ohio and Great Kanawha Rivers, and is known as the Broad-bill and Big Black-head.

21. LESSER SCAUP DUCK.

Aythya affinis (Eyt.).

Transient visitant; common. This species is more common than the foregoing. I observed it on the Monongahela River; also on Valley River September 24.

22. GOLDEN-EYE.

Glaucionetta clangula americana (Bonap.).

Transient visitant; tolerably common. I did not meet with this Duck, but was informed by the captain of the Courier (one of the Ohio steamers) that it generally appears by the last week of September, and is known by the name of Whistler.

BUFFLE-HEAD.

Charitonetta albeola (Linn.).

sient visitant. Common on suitable streams throughout te, and one of the earliest ducks to arrive from the north I found it common on the Ohio September 26, and Greenbrier, Cheat, and South Branch of the Potomac

CANADA GOOSE.

Branta canadensis (Linn.).

sient visitant; abundant. I observed quite a large flock November 3, passing up the South Branch of the Potomac. They are called Wild Geese, and occasionally stop in some favorable locality to feed.

25. WHISTLING SWAN.

Olor columbianus (Ord.).

Transient visitant; tolerably common. I did not observe any swans, but was informed by people living at Romney that large flocks appear there in fall and spring. In the fall of 1887 great numbers were killed at that place on the meadows along the South Branch. Several pairs of wings were shown me which were secured at that time.

26. BITTERN.

Botaurus lentiginosus (Montag.).

Summer resident; common. Breeds in suitable localities throughout the State.

27. LEAST BITTERN.

Botaurus exilis (Gmel.).

Summer resident; probably of rare occurrence. I saw but one, which flew up from a reedy swamp along the banks of Great Kanawha River. Dr. Mathers informs me that he has taken it on Buckhannon River in summer.

28. GREAT BLUE HERON.

Ardea herodias Linn.

Summer resident; common. I found it more plentiful o Ohio, Monongahela, Great Kanawha, and Cheat Rivers elsewhere. It breeds in pairs in Buckhannon, Middle F and Greenbrier Rivers, where it is known by the nam Crane. The Great Blue Heron feeds principally on frogs, and mice.

29. AMERICAN EGRET.

Ardea egretta Gmel.

Accidental visitant from the South. Only two instances of its occurrence in the State have come to my knowledge. Dr. Mathers informed me that a single specimen was taken near Buckhannon several years ago, and Mr. Brown, of Parkersburg, procured one in the summer of 1886, on Little Kanawha River. It is commonly known by the name of White Crane.

30. LITTLE BLUE HERON.

Ardea cœrulea Linn.

Summer resident; rare. I observed a single individual of this species on Blennerhassett Island October 3. I also saw a mounted specimen in Charleston, which had been shot in July on Great Kanawha River.

31. GREEN HERON.

Ardea virescens Linn.

Summer resident; common. Found throughout the country visited. It frequently breeds in colonies of four to eight pairs Occasionally a single pair takes up its abode in an orchard at some distance from any stream. It is often named Poke or Fly-up-the-creek.

32. BLACK-CROWNED NIGHT HERON.

Nycticorax nycticorax nævius (Bodd.).

Transient visitant; tolerably common. A few may breed along the head-waters of Valley and Cheat Rivers. It was not ith on the Ohio until after October 12.

SANDHILL CRANE.

Grus mexicana (Mull.).

cidental straggler. Mr. E. L. Day, of Buckhannon, in-ed me that a resident of Upshur County killed a fine speci- of this species near that place in the spring of 1884.

4. VIRGINIA RAIL.

Rallus virginianus Linn.

ansient visitant; tolerably common in suitably localities throughout the country visited after September 24. Several sportsmen informed me that it sometimes breeds along the Ohio River.

35. SORA.

Porzana carolina (Linn.).

Transient visitant; tolerably common. Frequents the same localities as the Virginia Rail.

36. FLORIDA GALLINULE.

Gallinula galeata (Licht.).

Accidental visitant. A specimen of this species was killed by a resident of Weston, Lewis County, July 30, 1888. It may

occur regularly in spring and fall along the Ohio River, but I did not meet with it.

37. COOT.

Fulica americana Gmel.

Transient visitant; common along streams and ponds throughout the State. Probably breeds along Cheat River and the head-waters of Valley River, where I procured a specimen August 21. It was very common on the Ohio after October 1.

38. NORTHERN PHALAROPE.

Phalaropus lobatus (Linn.).

Transient visitant; rare. I killed a specimen on the Ohio River, north of Parkersburg, Wood County, Septembe which was the only one seen. E. L. Day, of Buckhannor a stuffed specimen which he took along that river.

39. WOODCOCK.

Philohela minor (Gmel.).

Summer resident; common. Generally distributed thr out the sections visited. A lover of low, damp places.

40. WILSON'S SNIPE.

Gallinago delicata (Ord.).

Transient visitant. Though tolerably well distributed, are more common along the Ohio, Great Kanawha, and South Branch of the Potomac, where they afford fine shooting in early spring. I flushed a single bird August 30 in Thomas Farnsworth's meadow, near Buckhannon.

41. LEAST SANDPIPER.

Tringa minutilla Vieill.

Transient visitant. Tolerably common along the principal streams after September 24, especially so along the Ohio River.

42. GREATER YELLOW-LEGS.

Totanus melanoleucus (Gmel.).

Transient visitant; rare. I observed two birds only of this

noisy and well known species. They were on the meadows below Point Pleasant, near the Ohio River.

43. SOLITARY SANDPIPER.

Totanus solitarius (Wils.).

Transient visitant; rare. This bird does not frequent open meadows, as does the last named species, but inhabits unfrequented low woods and swampy places covered with alders. It may be more common during the spring migrations than in the fall. I observed a few near Huntington October 14.

44. BARTRAMIAN SANDPIPER.

Bartramia longicauda (Bechst.).

ummer resident; tolerably common near Buckhannon dur- the month of August, but more plentiful after September I found it very shy and exceedingly hard to approach. It uents cultivated fields and uplands, and is known in all sec- is as Upland Plover.

45. SPOTTED SANDPIPER.

Actitis macularia (Linn.).

Summer resident; common along all streams and ponds. It known as the Little Tilt-up.

46. KILLDEER PLOVER.

Ægialitis vocifera (Linn.).

Summer resident; common. Tolerably abundant during migrations. It is said that a few occasionally remain through the winter season along the Great Kanawha and in the Ohio Valley. Their chief resorts are newly-plowed fields and banks of streams and meadows. In some localities the Killdeer does much good by feeding on grasshoppers.

47. BOB-WHITE; QUAIL.

Colinus virginianus (Linn.).

Resident; common; abundant in a few favored localities. Certain farmers informed me that Quail are very destructive to their grape crops, and also to wild grapes, and maintain that

they should be killed all the year round. This opinion, which may prevail among many casual observers, is likely to hasten the extermination of this noble game-bird, and there is little doubt that it has caused the scarcity of the species in some localities. The law in regard to this game-bird (as well as others) should be more stringent. Quail are beneficial birds, and are seldom injurious to the farmer or fruit-grower. I was informed that Quail were abundant throughout the Ohio Valley a few years ago, but at the present time they cannot be classed as more than a common resident. In the counties bordering the Alleghanies they are still plentiful. They are generally known as Virginia Partridge or Quail. Stomachs of spe[illegible] cured contained blackberries, seeds of smartweed, [illegible] pea, partridge pea, Solomon's seal, hemlock, sum[illegible] dogwood, wheat, traces of beetles and *Hymenoptera* [illegible]

48. RUFFED GROUSE.

Bonasa umbellus (Linn.).

Resident and common throughout all sections visit[illegible] generally called Pheasant. Its food consists of vari[illegible] and fruits, of which the following may be mentione[illegible] birch (*Betula nigra*), beech (*Fagus ferruginea*), [illegible] (*Rubus canadensis*), black raspberry (*Rubus occident*[illegible] raspberry (*R. strigosus*), blue tangle-berry (*Gaylussa*[illegible]*dosa*), common black huckleberry (*G. resinosa*), deerberry (*Vaccinium stamineum*), blueberry (*V. pennsylvanicum*,) and great numbers of insects. During the season when grasshoppers and crickets are abundant, the Grouse flock to the openings and feed greedily upon them.

49. WILD TURKEY.

Meleagris gallopavo Linn.

Resident; tolerably common. Turkeys are plentiful in parts of Greenbrier, Pocahontas, Randolph, Tucker, Grant, Hardy, and Hampshire Counties, and frequent the highest points of the Alleghanies. They feed upon corn, acorns, wheat, buckwheat, oats, the fruit of river birch (*Betula nigra*), chestnut (*Castanea vesca americana*), beech (*Fagus ferruginea*), red

raspberry (*Rubus strigosus*), black raspberry (*R. occidentalis*), dewberry (*R. canadensis*), blackberry (*R. villosus*), sumach (*Rhus glabra*), common black huckleberry (*Gaylussacea resinosa*), seeds of various grasses, and insects. They destroy large numbers of the red-legged grasshopper (*Caloptenus femur-rubrum*).

50. PASSENGER PIGEON.

Ectopistes migratorius (Linn.).

An irregularly common spring and fall visitor. It was last seen in large numbers in the fall of 1883. Beechnuts, acorns, and chestnuts constitutes its principal food in the fall of the year.

51. MOURNING DOVE.

Zenaidura macroura (Linn.).

Summer resident; abundant along the river bottoms. Stomachs and crops of specimens secured contained buckwheat and seeds of rag or bitter weed.

52. TURKEY VULTURE.

Cathartes aura (Linn.).

Resident; common; breeds in the mountain districts, and may be seen flying over the valleys at any time. Turkey Buzzards feed upon carrion, and are very useful birds.

53. SWALLOW-TAILED KITE.

Elanoides forficatus (Linn.).

An accidental straggler from the south. I procured a fine specimen near the Gauley Mountains August 26. E. L. Day, of Buckhannon, took one a few years ago near the same place. The food of this species consists chiefly of insects and their larvæ, snakes, lizards, and probably frogs and toads.

54. MARSH HAWK.

Circus hudsonius (Linn.).

Summer resident; tolerably common. I met with this species August 5, at Buckhannon, flying over the meadows. I

also secured a specimen at Fairmont September 14. As it is a lover of marshy meadows it was seen more often in such places than in the mountain districts. Its food consists largely of injurious rodents of which the meadow mice (*Arvicolæ*) constitute a large proportion. In the west it kills great numbers of Striped Gophers (Ground Squirrels). Small birds, especially ground loving species, are sometimes taken. Stomach of specimen secured contained a Chipping Sparrow.

55. SHARP-SHINNED HAWK.

Accipiter velox (Wils.).

Resident; common. Universally distributed throughout the country visited, and as often found in the farming as in the wooded districts. The food of this species consist almost entirely of small birds and young poultry. Stomachs of the three specimens received contained two Song Sparrows and one Goldfinch.

56. COOPER'S HAWK.

Accipiter cooperi (Bonap.).

Resident; tolerably common. Cooper's Hawk is a bold, swiftly flying species which feeds largely upon poultry, game, and other birds. To the depredations of this, the preceding, and the following species may be attributed most of the feeling of hatred so generally shown by farmers toward all our hawks.

57. GOSHAWK.

Accipiter atricapillus (Wils.).

Winter visitant; rare in the mountain districts. During severe winters it has been taken several times along the Ohio River. Its food consists largely of game and poultry.

58. RED-TAILED HAWK.

Buteo borealis (Gmel.).

Resident; common along the river bottoms, but less so in the Ohio and Kanawha Valleys. It is generally known as Chicken Hawk, as are all of the larger Hawks. Feeds principally on mice.

59. RED-SHOULDERED HAWK.

Buteo lineatus (Gmel.).

Resident; tolerably common, particularly in the mountain district. I took a specimen September 21. Feeds principally on small mammals, reptiles, and insects.

60. BROAD-WINGED HAWK.

Buteo latis imus (Wils.).

Resident; tolerably common. Frequents the heavy timber. I took several specimens while on the head-waters of Buckhannon River during the last of August. Stomach of specimen secured contained remains of water snake and larvæ of moths.

61. GOLDEN EAGLE.

Aquila chrysaetos (Linn.).

Very rare; occurs only at intervals during spring and fall. Oct. 17, I saw the remains of what must have been a fine specimen of this Eagle. It was nailed to the side of a mountaineer's cabin near Beaver Lick mountains, Pocahontas County, and was shot in the mountains that spring while feeding upon a Wild Turkey. The same person informed me that they frequently appear in the fall but he did not know of their breeding.

62. BALD EAGLE.

Haliæetus leucocephalus (Linn.).

Resident; tolerably common; breeds in suitable places over the eastern portions of the State. It is of frequent occurrence throughout the Ohio Valley during the early spring and fall. Its food consists principally of fish, occasionally waterfowl, and rarely the young of domesticated animals.

63. DUCK HAWK

Falco peregrinus anatum (Bonap.).

Resident in the mountains. Common everywhere along the river bottoms and in the forests that cover the higher peaks and

ridges. I secured three fine specimens, one adult and two young, on Rich mountains near the head-waters of Middle Fork River in August. I did not observe any below an altitude of 1,500 feet. The stomachs of those killed contained remains of Quail (*Colinus virginianus*), Cedar Waxwing (*Ampelis cedrorum*), Cardinal Grosbeak (*Cardinalis cardinalis*) and Chipmunk (*Tamias striatus*). They also feed upon ducks, poultry, and game birds.

64. SPARROW HAWK.

Falco sparverius Linn.

Resident; abundant throughout all sections visited. It breeds in holes in trees, often selecting one in close proximity to farm buildings. This active little bird is familiarly known by every one, and the countless numbers of injurious insects and mice it destroys should command for it the respect and protection of every farmer. It is said to take young chickens occasionally, but of this we have no evidence. Even if this be true it repays tenfold the mischief done in that way by clearing out the noxious vermin that infest barns, outbuildings, and meadows. It feeds principally upon grasshoppers and mice. Stomachs of specimen secured contained grasshoppers, crickets, and katy-dids.

65. OSPREY; FISH HAWK.

Pandion haliætus carolinensis (Gmel.)

Summer resident; common. Most plentiful along the larger streams during spring and fall migrations. It is known by the name of Fish Hawk.

66. BARN OWL.

Strix pratincola Bonap.

Resident; common. I found this species in the mountain districts where it frequents the small meadows and river bottoms, remote from towns. I have frequently found it feeding in the day time. Aug. 23 I killed one which had just captured a Chipmunk.

67. LONG-EARED OWL.

Asio wilsonianus (Less.).

Resident; tolerably common. Frequents deep woods.

68. SHORT-EARED OWL.

Asio accipitrinus (Pall.).

Resident; tolerably common. Frequents the low grassy meadows, over which it may sometimes be seen hunting in the day time. The food of this species consists chiefly of mice, sqirrels, insects, and occasionally small birds. Seldom, if ever, does it prey upon the farmer's chickens.

69. BARRED OWL.

Syrnium nebulosum (Frost.).

Resident; common. Large numbers of this species are found throughout the mountain ranges. Mice and insects constitute the principal food of the Barred Owl.

70. SAW-WHET OWL.

Nyctala acadica (Gmel.).

Rare; probably resident in the mountains. I did not encounter it until the last of October, at which time I heard an individual in the evening, along Cheat River.

71. SCREECH OWL.

Megascops asio (Linn.).

Resident; abundant. Generally distribnted throughout all localities. A very useful species, destroying large numbers of mice and noxious insects.

72. GREAT HORNED OWL.

Bubo virginianus (Gmel.).

Resident; common. This powerful bird is the largest Owl found in the State. It frequents heavy timber and is seen only occasionally during the day. When thus found and started it is sure to attract the attention of a large audience of small birds. Stomachs of specimens secured contained the remains of a rabbit, crawfish, and May beetle.

73. SNOWY OWL.

Nyctea nyctea (Linn.).

Winter visitant; rare. Dr. Mathers informs me that Snowy Owls are occasionally seen during severe winters.

74. YELLOW-BILLED CUCKOO.

Coccyzus americanus (Linn.).

Summer resident; common. Both this and the following species are called Rain Crow. They frequent the same localities, although I found the Yellow-billed ranging higher up the mountains than the Black-billed. Both are beneficial as insect destroyers. Stomachs of specimens secured contained grasshoppers, crickets, and daddy-long-legs.

75. BLACK-BILLED CUCKOO.

Coccyzus erythrophthalmus (Wils.).

Summer resident; common. Frequents the orchards and shade trees of the towns, in company with the Yellow-billed.

76. BELTED KINGFISHER.

Ceryle alcyon (Linn.).

Summer resident; abundant along all streams and ponds throughout the portions of country visited. It feeds mainly upon fish of different kinds.

77. HAIRY WOODPECKER.

Dryobates villosus (Linn.).

Resident; rather common along the river bottoms and in the mountain districts, but not confined to any particular locality. It was not as common in the cultivated districts as the Downy Woodpecker. It would be very difficult indeed to find a more beneficial class of birds than the Woodpeckers, and they should be universally respected and protected. In the agricultural districts they benefit the trees among which they live, as they are always busily engaged in removing the larvæ of the various boring insects which infest the bark and wood. Stomachs of specimens secured contained traces of *Hymenoptera*, beetles, larvæ of moths, blackberries, corn, and traces of decayed wood.

78. DOWNY WOODPECKER.

Dryobates pubescens (Linn.)

Resident; common. Found everywhere, and like the Hairy very industrious. Of all our Woodpeckers it is by far the most useful to the agriculturist, although many people believe it is attracted to orchards by the sap the trees contain, and hence have named it Sapsucker. I found that name general throughout all sections visited. It does not feed upon the sap of trees, but being a skillful insect hunter, it penetrates the bark where the insects are doing the greatest damage. Stomachs of specimens secured contained remains of beetles, *Hymnoptera*, and larvæ of *Lepidoptera*.

79. YELLOW-BELLIED SAPSUCKER.

Sphyrapicus varius (Linn.).

Transient visitant; common. Did not meet with this species until October 1, when it was found frequenting woods and small groves along the valleys. I have no doubt that it may breed among the higher mountain ridges along the headwaters of Cheat River. It is shy and hard to approach.

80. PILEATED WOODPECKER.

Ceophlœus pileatus (Linn.).

Resident; common. Saw them frequently among the girdled trees in the mountain sections. They were so shy that it was impossible to get within shooting distance. I killed one while it was feeding on the ground. Its stomach contained the remains of corn and the common red ant (*Formica sanguinea.*)

81. RED-HEADED WOODPECKER.

Melanerpes erythrocephalus (Linn.).

Summer resident; common. Most plentiful through the farming districts and river bottoms. At Buckhannon they were abundant during August. Stomachs of specimens secured contained grasshoppers, black ants, beetles, fruit of sour gum, blackberry, wild cherry, corn, buckwheat, seeds of swart-weed, and the pulp of apples.

82. FLICKER.

Colaptes auratus (Linn.).

Summer resident; abundant throughout all sections. Stomachs of specimens secured contained fruit of sour gum, black raspberry, black ants, traces of beetles, *Hymenoptera*, and corn.

83. WHIP-POOR-WILL.

Antrostomus vociferus (Wils.).

Summer resident; common. This species is well known by its notes. Being insectivorous, it is an exceedingly useful bird, destroying millions of injurious insects.

84. NIGHTHAWK.

Chordeilles virginianus (Gmel.).

Summer resident; abundant; was not seen after Sept. 15. Like the last named species it is a very useful bird. Its food consists of winged insects.

85. CHIMNEY SWIFT.

Chætura pelagica (Linn.)

Summer resident; abundant everywhere. Breeds in the mountain districts in trees. I did not observe very many around the chimneys, and I think the use of soft coal prevents them from breeding in such places.

86. RUBY-THROATED HUMMING-BIRD.

Trochilus colubris Linn.

Summer resident; common. The food of the Humming-bird consists of the honey of flowers, small insects, and spiders. They seem to prefer the flowers of the common horse chestnut (*Æsculus hippocastanum*), honeysuckles (*Lonicera*), and trumpet creeper (*Tecoma*). In eastern Pennsylvania I found three species of spiders in their stomachs, namely, *Epeira fasciata*, *E. hortorum*, and *Thomisus fartus*.

87. KINGBIRD.

Tyrannus tyrannus (Linn.).

Summer resident; abundant everywhere, though most com-

mon in the river bottoms. It is generally known as the Bee Martin. Stomachs of the specimens secured contained traces of beetles, grasshoppers, black ants, red raspberries, blackberries, and wild cherries.

88. GREAT CRESTED FLYCATCHER.

Myiarchus crinitus (Linn.).

Summer resident; common along the rivers where heavy timber abounds. This species differs from the rest of the family of Flycatchers, inasmuch as it builds its nests in holes in trees and stubs. Occasionally it nests close to farm buildings. In never excavates holes for itself, but finds a natural hollow or a deserted Woodpecker's hole. In eastern Pennsylvania its food consists largely of the following insects: *Anisopterix pometaria* and *A. vernata*, *Pieris oleracea* (Oleracea Butterfly), *P. rapæ* (the imported cabbage butterfly), *Colias philodice* (sulphur butterfly), corn worm (*Gortyna zeæ*), house fly (*Musca domestica*), white-lined house fly (*Tabanus lineola*), stable fly (*Stomoxys calcitrans*), red ant *Formica sanguinea*), field cricket (*Gryllus abbreviatus*), mosquito (*Culex tæniorhynchus*), and red-legged locust (*Caloptenus femur-rubrum*), besides large numbers of beetles. They occasionally feed upon the fruit of wild strawberry (*Fragaria virginiana*) and wild red raspberry (*Rubus strigosus*).

89. PHŒBE.

Sayornis phœbe (Lath.).

Summer resident; common. This agreeable bird was met with everywhere. Its food, like that of all Flycatchers, consists mainly of insects. In addition to the insects mentioned under the last species the following have been found in stomachs of those killed in eastern Pennsylvania: Crane fly (*Tipula ferruguinea*), banded horse fly (*Tabanus cinctus*) Turnus butterfly (*Papilio turnus*), ground beetle) *Lachnosterna quercina*). I have also found them feeding occasionally on the fruit of red cedar (*Juniperus virginiana*) and red currant (*Ribes rubrum*).

90. OLIVE-SIDED FLYCATCHER.

Contopus borealis (Swains.).

Transient visitant; rare. Observed two Sept. 30 on the Little Kanawha River, both of which were captured. Contents of the stomachs consisted of black crickets (*Acheta nigra*), mosquitoes (*Culex tæniorhynchus*), and red ants (*Formica sanguinea*).

91. WOOD PEWEE.

Contopus virens (Linn.).

Summer resident, common. The Wood Pewee frequents dense forests, both evergreen and deciduous, where it finds its insect food abundant. Among other insects on which it preys may be mentioned the larvæ of the butterflies *Grapta interrogationis and Argynnis cybele*, tent caterpillars (*Clisiocampa americana*), house fly (*Musca domestica*) and red ant (*Formica sanguinea*).

92. YELLOW-BELLIED FLYCATCHER.

Empidonax flaviventris Baird.

This species, which at a distince resembles the Wood Pewee, was not observed. I saw a stuffed specimen in Charleston that had been shot near that place in the spring of 1887.

93. ACADIAN FLYCATCHER.

Empidonax acadicus (Gmel.).

Summer resident; tolerably common. This species is somewhat shy and retiring, frequenting heavy timber near streams and small water courses. Stomachs of specimens secured contained traces of *Diptera*.

94. LEAST FLYCATCHER.

Empidonax minimus Baird.

Transient visitant; probably breeds. I found it common along the borders of the small streams and in small groves and orchards. Stomachs of specimens secured contained traces of beetles.

95. BLUE JAY.

Cyanocitta cristata (Linn.).

Resident; common. A familiar species and one that is distributed throughout the State. Stomachs of specimens secured contained wheat, corn, blackberries, grasshoppers, traces of beetles, larvæ of moths.

96. RAVEN.

Corvus corax sinuatus (Wagl.).

Resident; tolerably common in the mountain districts. While passing over the Alleghanies during the middle of October I saw several Ravens, but was unable to secure a specimens. I was informed by the inhaditants that they are very destructive to the poultry, especially during the months of May and June.

97. CROW.

Corvus americanus Aud.

Resident; abundant and exceeding shy. Of all the birds that inhabit the State the Crow is the most omnivorous. No species has been more persecuted by the farmer, and yet the most of the mischief they do is in the early spring, while they have young nestlings to care for, and it is then they steal a few young birds, chickens, and eggs. For the little corn-pulling they do they amply repay the farmer by destroying multitudes of injurious insects that frequent his cornfields. I have watched them at a distance by the aid of a field glass while in a field where corn was standing, partly in heaps that had been husked out. The Crows did not disturb the corn but fed upon insects and the seeds of bitter weeds. The evil which they do lasts but a brief period, whereas their good services continue during the entire year.

98. FISH CROW

Corvus ossifragus Wils.

Resident; rare. I saw two Fish Crows on Blennerhassett Island October 2. They were flying across from the island to the Ohio side.

99. BOBOLINK.

Dolichonyx oryzivorus (Linn.)

Transient visitant; common. May breed in the higher portions of the State. I observed these birds wending their way south on the morning of September 5. In the north their food consists of seeds of various grasses and weeds, grubs, beetles, grasshoopers, and crickets. Stomachs of specimens secured contained seeds of foxtail grass.

100. COWBIRD.

Molothrus ater.

Summer resident; common, frequenting cultivated districts, particularly about meadows and rivers. It is known along the Great Kanawha as Salt Bird. This species does not build a nest but lays its eggs in other birds' nests. Dr. Coues in his *Birds of the Northwest* gives an interesting pen-sketch of this species. He says: "It is interesting to observe the female Cowbird ready to lay. She becomes disquieted; she betrays unwonted excitement, and ceases her busy search for food with her companions. At length she separates from the flock, and sallies forth to reconnoitre, anxiously indeed, for her case is urgent, and she has no home. How obtrusive is the "sad" analogy. She flies to some thicket or hedge-row, or other common resort of birds, where something teaches her—perhaps experience—nests will be found. Stealthily and in perfect silence she flits along, peering furtively, alternately elated or dejected, into the depth of the foliage. She espies a nest, but the owner's head peeps over the brim, and she must pass on Now, however, comes her chance; there is the very nest she wishes, and no one at home. She disappears for a few minutes, and it is almost another bird that comes out of the bush. Her business done, and trouble over, she chuckles her self-gratulations, rustles her plumage to adjust it trimly, and flies back to her associates. They know what has happened, but are discreet enough to say nothing—charity is often no less wise than kind." Stomachs of specimens secured contained timothy and clover seeds.

101 YELLOW HEADED BLACKBIRD.

Xanthocephalus xanthocephalus (Bonap.).

Accidental visitant; rare. Not observed by me. Dr. Mathers took one in the spring of 1886 near Buckhannon, Upshur Co.

102. RED-WINGED BLACKBIRD.

Agelaius phœniceus (Linn.).

Summer resident; abundant in wet meadows and low lands, and always gregarious, breeding in colonies. Most of them go south by the last of August. They are generally known by the name of Swamp Blackbird Stomachs of specimens secured contained grasshoppers, katy-dids, seeds of ragweed, smartweed, and blackberries, oats, wheat, and timothy.

103. MEADOW LARK.

Sturnella magna (Linn.)

Resident; abundant. It is very fond of low meadow lands, but sometimes frequents higher elevated fields. Stomachs of specimen secured contained grasshoppers.

104. ORCHARD ORIOLE.

Icterus spurius (Linn.).

Summer resident; tolerably common. Found mostly among small groves along the valleys and in orchards bordering such places. Its food consists mainly of insects.

105. BALTIMORE ORIOLE.

Icterus galbula (Linn.).

Summer resident; common. This brilliant-plumaged bird is known throughout the State as Hanging-bird." It is more familiar than its near relative the Orchard Oriole, and often makes its home in or near the towns. It is insectivorous, and feeds largely upon coleopterous and hymenopterous insects, together with the leaves of the various *Lepidoptera*.

106. RUSTY BLACKBIRD.

Scolecophagus carolinus (Mull.).

Transient visitant; common. Small flocks were met with during the last week in October, frequenting swamp and low lands. Stomachs of specimens secured contained elderberries, and traces of larvæ of *Lepidoptera* and *Coleoptera*.

107. PURPLE GRACKLE.

Quiscalus quiscula (Linn.),

Summer resident; abundant. This species is generally called Crow Blackbird. It is condemned by the farming classes who give it a very bad reputation. It comes in small flocks in early spring, generally frequenting meadows and cultivated fields, and destroying large numbers of insects. As spring advances and the farmers begin to plow, I have observed dozens of these birds following the fresh turned furrows, picking up white grubs and earth worms. After the field has been planted with corn and the tender blades appear, the Blackbirds visit the fields and pluck the young sprouts from their beds, eating the grain and scattering the blades promiscuously around. I have killed them while thus engaged, and their stomachs contained, besides grains of corn, cut worms of various kinds. Still later in the season they feed upon oats and corn in the shock. On my arrival in Buckhannon, August 1, I was informed that a few days previously large numbers of these Blackbirds had congregated every evening in a small field in which oats were standing in shocks, near the town, affording fine shooting for the young sportsmen of the borough. I visited the place August 2, but the grain had been gathered. I found a few birds feeding upon the ground and exceedingly hard to approach. Those that were procured contained oats and clover seeds. Notwithstanding the injury done to farm crops by this species, it does a vast amount of good by destroying innumerable insects. Stomachs of specimens secured contained oats, clover seed, blackberries, and traces of beetles.

108. ENGLISH SPARROW.

Passer domesticus (Linn.).

Resident; abundant. This pest is most plentiful along the lines of the Baltimore & Ohio and Chesapeake & Ohio Railroads. Remote from these lines, and in the interior of the State, it seems to be only tolerably common, but it is increasing each year. I observed it in all the boroughs and smaller villages. In many rural districts it has become the principal species, especially in the Ohio Valley, and it has spread even to the foot hills of the mountains. In regard to this bird as a fruit destroyer, on several occasions I have seen it deliberately plunge its bill into cultivated grapes to obtain the juice, thus destroying large numbers by causing them to wither and decay. The following list embraces much of its food: buds and blossoms of the maple, cherry, apple, pear, and plum; fruits of strawberries, raspberries, blackberries, and grapes; bits of bread, cabbage, potatoes, wheat, corn, and oats; salad, peas, and other herbaceous plants, with a change to a few insects occasionally, but these are few in numbers. Sometimes it feeds upon the seeds of ragweed (*Ambrosia artemisiæfolia*), pigweed (*Amarantus albus*), and lambs' quarters (*Chenopodium album*).

109. PURPLE FINCH.

Carpodacus purpureus (Gmel.).

Transient visitant; tolerably common. I observed a few on November 4 near Romney, Hampshire County.

110. RED CROSSBILL.

Loxia curvirostra minor (Brehm).

Winter visitant; tolerably common. This and the following species are generally confounded under the name Crossbill. In these birds the mandibles are rather long, thick at the base, much curved, and cross each other when the bill is closed. Their food consists principally of seeds of coniferous trees.

111. WHITE-WINGED CROSSBILL.

Loxia leucoptera Gmel.

Winter visitant; rare. Several were taken by Mr. Brown, of Parkersburg, in the pine districts on the east slope of the Alleghanies during severe winters.

112. GOLDFINCH.

Spinus tristis (Linn.).

Resident; common and generally distributed, but not frequently seen after October 20. The Salad bird, as it is known throughout the State, is chiefly a granivorous species, preferring seeds at all times; still it destroys numbers of small insects while it has young to care for. Stomachs of specimens secured contained weed seeds.

113. SNOWFLAKE.

Plectrophenax nivalis (Linn.).

Winter visitant; said to be tolerably common in the mountain districts, where it is known as the White Snowbird.

114. VESPER SPARROW.

Poocætes gramineus (Gmel.).

Summer resident; tolerably common. Generally called Bay-winged Bunting, or Grassfinch. It frequents old fields and the thickets bordering them.

115. WHITE-CROWNED SPARROW.

Zonotrichia leucophrys (Forst.).

Winter visitant; common. I found them along the Ohio River in thickets and wooded districts by October 10.

116. WHITE-THROATED SPARROW.

Zonotrichia albicollis (Gmel.).

Winter resident; common. I found them in company with the White-crowned Sparrow, which frequents much the same kinds of places, and resembles it in habits. Stomachs of specimens secured contained pigweed and other weed seeds.

117. TREE SPARROW.

Spizella monticola (Gmel.).

Winter resident; common. I saw Tree Sparrows in all sections visited after September 20. Stomach of specimen contained clover seed.

118. CHIPPING SPARROW.

Spizella socialis (Wils.).

Summer resident; common and generally distributed. This species is familiar to every one. It prefers farming districts to waste fields, thickets, and forests, although I occasionally found it in the mountains. Stomach of specimen secured contained weed seeds.

119. FIELD SPARROW.

Spizella pusilla (Wils.).

Summer resident; common; frequents cultivated fields and pastures. Stomach of specimen secured contained grass seeds.

120. SLATE-COLORED JUNCO.

Junco hyemalis (Linn.).

Winter resident. I observed them in the Ohio Valley by September 28, frequenting meadows, thickets, and open fields. It is known as the Black Snowbird. Stomachs of specimens secured contained clover and weed seeds.

121. CAROLINA JUNCO.

Junco hyemalis carolinensis Brewst.

Resident in the higher mountains. I found them August 26 on Rich Mountains, where I was informed they breed. I secured several specimens, but as they were lost with the rest of my skins, I was unable to compare them with the northern form. In the mountain form the under parts are clearer white, the back a brighter blue, and the size somewhat larger than in *hyemalis*. The bill is dark horn color.

122. SONG SPARROW.

Melospiza fasciata (Gmel.).

Resident; abundant and universally distributed, associating with the other Sparrows that frequent open fields, pastures, and groves and orchards. Stomachs of specimens secured contained seeds of foxtail and timothy grass, clover, smartweed and other weed seeds, and traces of beetles.

123. LINCOLN'S SPARROW.

Melospiza lincolni (Aud.).

Transient visitant; rare. I took one September 26 in the Ohio Valley. It was in a thicket of low brush, and was the only one seen.

124. SWAMP SPARROW.

Melospiza georgiana (Lath.).

Winter resident; probably breeds in the higher portions of the State. Common in the Ohio Valley after October 8, frequenting low grounds and borders of woods.

125. FOX SPARROW.

Passerella iliaca (Merr.).

Winter resident; tolerably common. This species was observed among the thickets and underbrush in the vicinity of Romney, Hampshire County, October 29.

126. TOWHEE.

Pipilo erythrophthalmus (Linn.).

Summer resident. Abundant throughout waste grounds and forests, even to the very highest points visited. It is known by the names Ground Robin and Chewink. Stomachs of specimens secured contained seeds of smartweed and traces of *Coleoptera*.

127. CARDINAL.

Cardinalis cardinalis (Linn.).

Resident. Common along the river bottoms, and in fact in all thickets and damp woods in the valleys, where it is known as Redbird and Cardinal Grosbeak. Stomachs of specimens secured contained traces of beetles, blackberry and clover seeds, wheat, and seeds of partridge pea.

128. ROSE-BREASTED GROSBEAK.

Habia ludoviciana (Linn.).

Summer resident; tolerably common. I met with this species the last of August on the head waters of Buckhannon

River, where it appeared to be more common than elsewhere. During the early spring and summer months it prefers open woodlands, close to running streams, although I have observed it in cultivated fields in search of insects. The farmers and fruit growers should become acquainted with this bird, as it stands among the first of the beneficial kinds. It is one of the few species which feed upon the potato beetle.

129. BLUE GROSBEAK.

Guiraca cærulea (Linn.).

Summer resident; apparently rare. I saw three in an old grove near Buckhannon, Upshur County, August 15.

130. INDIGO BUNTING.

Passerina cyanea (Linn.).

Summer resident. Common and generally distributed, but most plentiful along the borders of woods and clearings. It is called Indigo Bird.

131. DICKCISSEL.

Spiza americana (Gmel.).

Summer resident; tolerably common to the Ohio Valley, but not seen elsewhere. I found it most plentiful in fields and pastures, especially clover fields.

132. SCARLET TANAGER.

Piranga erythromelas Vieill.

Summer resident; tolerably common. I observed this species only upon Rich Mountains, where it inhabits heavy timber, and is generally known as the Black-winged Redbird.

133. SUMMER TANAGER.

Piranga rubra (Linn.).

Summer resident; common. It frequents woodland along the valleys. On the headwaters of Buckhannon River it was more common than the Scarlet Tanager.

13 . PURPLE MARTIN.

Progne subis (Linn.).

Summer resident. Common in towns where boxes have been put up for them. As the English Sparrows are increasing, the Martins are fast disappearing. I did not observe any after September 1.

135. CLIFF SWALLOW.

Petrochelidon lunifrons. (Say.).

Summer resident; common. Found everywhere in bottom lands along the streams, where it breeds. I saw large numbers of their old nests hanging among the rocky cliffs. Swallows are strictly beneficial, destroying large numbers of insects. The Cliff Swallow is often called Mud Swallow.

136. BARN SWALLOW.

Chelidon erythrogaster (Bodd.).

Summer resident; abundant in the valleys.

137. TREE SWALLOW.

Tachycineta bicolor (Vieill.).

Summer resident; tolerably common along river bottoms, where it breeds in holes in trees. Unlike the other Swallows, it was not observed near the towns.

138. BANK SWALLOW.

Clivicola riparia (Linn.).

Summer resident; abundant along streams and railroad cuts, where it breeds in large numbers, nesting in holes bored into the banks.

139. ROUGH-WINGED SWALLOW.

Stelgidopteryx serripennis (Aud.).

Summer resident; common. I found it most plentiful in and around Buckhannon and Fairmont, which places seem to be well supplied with their favorite nesting resorts, which are stone culverts, bridges, and crevices of rocks.

140. CEDAR WAXWING.

Ampelis cedrorum (Vieill.).

Resident; abundant. This bird may be identified by the peculiar red and horny appendages usually attached to the tips of the inner wing quills, which resemble red sealing wax (from which it derives the name of Waxwing). The tail has a band of chrome yellow across the tip. These birds are fond of cherries and a few other garden fruits, but notwithstanding all that, they are much more beneficial than injurious, and for this reason should be protected. In different sections visited I observed small flocks feeding upon the berries of red cedar (*Juniperus virginiana*), deerberry or hackleberry (*Vaccenium stamineum*), and sour gum (*Nyssa multiflora*). The stomach of a specimen killed in West Virginia contained wild cherries. In eastern Pennsylvania I found the remains of the following insects in their stomachs: house fly (*Musca domestica*), stable fly (*Stomoxys calcitrans*), white-lined horsefly (*Tabanus lineola*), mosquito (*Culex tæniorhynchus*), rose slug (*Selandria rosæ*), and red-legged grasshopper (*Caloptenus femur-rubrum*).

41. NORTHERN SHRIKE.

Lanius borealis Vieill.

Winter visitant.

142. RED-EYED VIREO.

Vireo olivaceus (Linn.).

Summer resident; common throughout the State, but seems to prefer orchards and open woodlands, although I found it in the heavy forests that line Greenbrier and Cheat Rivers.

143. WARBLING VIREO.

Vireo gilvus (Vieill.).

Summer resident; common. The notes of this species may be heard during the middle of the day, when most other birds are silent. It is ever on the alert in quest of insects. It frequents small groves and orchards close to villages and towns. Its food consists chiefly of dipterous and lepidopterous insects.

144. YELLOW-THROATED VIREO.

Vireo flavifrons Vieill.

Summer resident; tolerably common. This beautiful Viero is olive-green on the back, and the throat and forebreast is bright yellow, changing to white on the belly. It frequents open woods and orchards, where it destroys large numbers of insects. Stomachs of specimens secured contain traces of *Hymenoptera*, *Coleoptera*, and larvæ of *Lepidoptera*.

145. BLUE-HEADED VIREO.

Vireo solitarius (Wils.).

Mr. Brewster, in his List of the Birds of Ritchie County, regarded this species as rather uncommon, but stated that it might breed, as he saw it as late as May 9.

146. WHITE-EYED VIREO.

Vireo noveboracensis (Gmel.).

Summer resident; common; frequents open woods and thickets. Its food is not known to differ from that of the other Vireos.

147. BLACK AND WHITE WARBLER.

Mniotilta varia. (Linn.).

Summer resident; common. This genial little Warbler was plentiful in August in the mountain districts, in which it breeds, but I do not think it nests outside of such places, as I did not observe it in the valleys and lower portion of the country. I found it frequently feeding upon the ground. Stomach of specimen secured contained traces of *Diptera*.

148. PROTHONOTARY WARBLER.

Protonotaria citrea (Bodd.).

Summer resident; rare. I took a specimen of this fine Warbler August 3 near Buckhannon, in a swampy woods. It was the only one seen.

149. WORM-EATING WARBLER.

Helmitherus vermivorus (Gmel.).

Summer resident; common. This species spends much of its time upon the ground, and is always engaged in hunting insects among the fallen leaves It frequents swampy thickets and hillsides covered principally with laurel (*Kalmia*).

150. BLUE-WINGED WARBLER.

Helminthophila pinus (Linn.).

Summer resident; tolerably common. During August I found this species in the mountain districts, where it breeds, but did not observe it anywhere else.

151. GOLDEN-WINGED WARBLER.

Helminthophila chrysoptera (Linn.).

Transient visitant. I did not observe this Warbler until September 10, at Fairmont, where it was found in woods along Buffalo Creek.

152. NASHVILLE WARBLER.

Helminthophila ruficapilla (Wils.).

Transient visitant. I did not meet with this species, but William Brewster recorded it from Ritchie County in 1874.

153. TENNESSEE WARBLER.

Helminthophila peregrina (Wils.).

Transient visitant; rare. I procured a young female in heavy timber on the banks of the Monongahela River, near Fairmont, September 12. The stomach contained small measuring worms.

154. PARULA WARBLER.

Compsothlypis americana (Linn.).

Summer resident; common. I found this species frequenting the forest and heavy timber along all streams. It was most plentiful during the month of September. It is known by the name of Blue Yellow-Backed Warbler. Stomach of specimen secured contained traces of larvæ of moths.

155. YELLOW WARBLER.

Dendroica æstiva (Gmel.).

Summer resident; common. This species is generally distributed throughout all sections visited, but was most common among the horse-chestnuts and maples in and around villages. It is generally called Summer Yellowbird.

156. BLACK-THROATED BLUE WARBLER.

Dendroica cærulescens (Gmel.).

Transient visitant; common, frequenting the wooded valleys and hillsides; occasionally found in open woods, where it is a busy gleaner of insects, chiefly beetles (*Coleoptera*).

157. MYRTLE WARBLER; YELLOW-RUMPED WARBLER.

Dendroica coronata (Linn.).

Transient visitant; abundant. I found these Warblers in the Ohio Valley by October 9, among low trees and bushes along the river bottom. Occasionally I found them in waste fields and open woods, where they feed upon the berries of red cedar (*Juniperus virginiana*), and various insects.

158. MAGNOLIA WARBLER.

Dendroica maculosa (Gmel.).

Transient visitant; tolerably common. This attractive little species was observed frequently among the orchards and small groves. During the last week in September I found it more plentiful on Blennnerhasstt Island than anywhere else. It is sometimes called Black and Yellow Warbler.

159. CERULEAN WARBLER.

Dendroica cærulea (Wils.)

Summer resident; tolerably common. I found this species in the heavy timbered bottom lands on the headwaters of Buckhannon River in August. It also frequents the higher wooded districts along the same stream. I did not observe it n any other locality.

160. CHESTNUT-SIDED WARBLER.

Dendroica pennsylvanica (Linn.).

Transient visitant; common. During the last week in September this species was seen in small flocks, composed of eight to ten birds, among the bushes along the Ohio and Little Kanawha Rivers.

161. BAY-BREASTED WARBLER.

Dendroica castanea (Wils.).

Transient visitant. I did not observe this species, but William Brewster states, in his Birds of Ritchie County, that Mr. Ingersoll took a specimen in that county May 14, 1874.

162. BLACK-POLL WARBLER.

Dendroica striata (Forst.).

Transient visitant; common; frequents swampy woods along streams. I met with it frequently on the banks of Buffalo Creek, below Fairmont, during the middle of September. Stomach of specimen secured contained traces of beetles and *Diptera*.

163. BLACKBURNIAN WARBLER

Dendroica blackburniæ (Gmel.).

Transient visitant. This charming little Warbler was restricted to heavy timber, frequenting the tops of tall trees for insects.

164. YELLOW-THROATED WARBLER.

Dendroica dominica (Linn.).

Summer resident; tolerably common. I last saw this species August 24, in the heavy timber along the head waters of Middle Fork River, and also high up the mountain side.

165. BLACK-THROATED GREEN WARBLER.

Dendroica virens (Gmel.).

Transient visitant; common; found in the same localities as *D. cærulescens*, both be ng frequently met with after September 24.

166. PINE WARBLER.

Dendroica vigorsii (Aud.).

Summer resident; rare. I met with this species once near Parkersburg, in a tract of pine timber along the Little Kanawha River. Mr. Brown, of that town, has two stuffed specimens that he took in the same place during July.

167. PALM WARBLER.

Dendroica palmarum (Gmel.).

Transient visitant; tolerably common. I observed this species frequenting the thickets and small trees along the South Branch of the Potomac River October 27. It was extremely shy. In eastern Pennsylvania I have found in the stomachs of this species red ants (*Formica sanguinea*), and house flies (*Musca domestica*).

168. PRAIRIE WARBLER.

Dendroica discolor (Vieill.).

Transient visitant; rare. I took a specimen of this species October 23 at Green Springs, Hampshire County, in a small belt of timber near the Potomac River. It was the only one observed.

169. OVEN-BIRD.

Seiurus aurocapillus (Linn.).

Summer resident; common in all wooded districts, but more plentiful in low damp woods in the mountains. It is chiefly terrestrial.

170. WATER-THRUSH.

Seiurus noveboracensis (Gmel.).

Summer resident; tolerably common along the streams and small pools which are plentiful in some sections towards the mountains. I did not observe them in the Ohio or Great Kanawha Valleys.

171. LOUISIANA WATER-THRUSH.

Seiurus motacilla (Vieill.).

Summer resident; common, frequenting the banks of streams and swampy and low damp woods where there is clear running water. It is an exceedingly shy species, and is mainly terrestrial.

172. KENTUCKY WARBLER.

Geothlypis formosa (Wils.).

Summer resident; tolerably common. It was met with very frequently along the low bushes that border the banks of Buckhannon River; also in the Ohio Valley near Parkersburg. Stomachs of specimens secured contained traces of *Hymenoptera* and *Diptera*.

173. MOURNING WARBLER.

Geothlypis philadelphia (Wils.).

Transient visitant; rare. I took one September 16, at Fairmont, where it was feeding among some low bushes in a swampy woods. Stomach of specimen secured contained traces of *Coleoptera* and larvæ of *Lepidoptera*.

174. MARYLAND YELLOW-THROAT.

Geothlypis trichas (Linn.).

Summer resident; common. This beautiful and active species is generally distributed throughout low swampy localities.

175. YELLOW-BREASTED CHAT.

Icteria virens (Linn.).

Summer resident; apparently rare. It frequents thickets and dense undergrowth on hillsides and is generally known as the ventriloquist of the woods. Persons not familiar with its habits may look for it in vain. One moment its notes are heard from a spot close by, and the very next they come from some distant point, always leaving one in doubt as to its whereabouts. This species is about the size of the Catbird. Its upper parts are bright olive green, the throat and breast are bright yellow, and the belly white.

176. HOODED WARBLER.

Sylvania mitrata (Gmel.).

Summer resident; tolerably common. I found this species both high up on the mountain and in the thickets and dense undergrowth along Buckhannon River, but did not meet with it in any other locality. Mr. W. E. D. Scott found it common and breeding in Kanawha County.

177. WILSON'S WARBLER.

Sylvania pusilla (Wils.).

Transient visitant; tolerably common. During the last week in September it was occasionally seen in retired places among low bushes bordering the hillsides along the Ohio Valley.

178. CANADIAN WARBLER.

Sylvania canadensis (Linn.).

Transient visitant; may breed in the higher mountains. This species frequents heavy timber. Occasionally it was seen in the cultivated fields where there were patches of second growth.

179. REDSTART.

etophaga ruticilla (Linn.).

Summer resident; common. This species is generally distributed. It is found not only in woodlands, but also among the maples that line the principal streets of the villages, where it is a busy little gleaner, spending most of its time in quest of insects. Stomach of specimen secured contained traces of *Diptera*.

180. MOCKINGBIRD.

Mimus polyglottos (Linn.).

Summer resident; rare. I observed this species September 27, on Blennerhassett Island, among the dense undergrowth. Mr. Brown informed me that he has taken it occasionally during the summer season.

181. CATBIRD.

Galeoscoptes carolinensis (Linn.).

Summer resident; abundant. This well known species was found everywhere and is detested by all the farmers and fruit growers. Admitting that it destroys some fruit, it may be said on the other hand that it does not give up destroying injurious insects for such food, and that its food consists chiefly of insects.

182. BROWN THRASHER.

Harporhynchus rufus (Linn.).

Summer resident; common. The Brown Thrush, as it is usually called, frequents heavy timber and waste grounds overgrown with brier bushes; also thickets bordering streams, gleaning much of its food from the ground. This species is one of our sweetest songsters. Its food consists largely of insects and berries. Stomachs of specimens secured contained berries of common elder.

183. CAROLINA WREN.

Thryothorus ludovicianus (Lath.).

Resident; common. This wren is much larger than the common House Wren (*Troglodytes ædon*). It is generally known around the sugar camp as "Sugar Bird." Stomach of specimen secured contained traces of beetles.

184. BEWICK'S WREN.

Thryothorus bewickii (Aud.).

Summer resident; rare. I observed a few in and around the villages and towns.

185. HOUSE WREN.

Troglodytes ædon Vieill.

Summer resident; common. This species is one of the boldest and most venturesome little creatures in the wren family. It makes its home in towns and villages throughout the State, and does much good by devouring multitudes of insects.

186. WINTER WREN.

Troglodytes hiemalis Vieill.

Winter resident; tolerably common. I did not meet with this species, but it has been recorded from the State.

187. LONG-BILLED MARSH WREN.

Cistothorus palustris (Wils.).

Summer resident; tolerably common. It was observed along the banks of the Ohio and Great Kanawha Rivers, among the flags and grasses that here and there border the streams.

188. BROWN CREEPER.

Certhia familiaris americana (Bonap.).

Winter resident; common. Dr. Mathers informed me that this little species is very plentiful during the winter months. It frequents dense forests, and occasionally is found among the orchards.

189. WHITE-BREASTED NUTHATCH.

Sitta carolinensis Lath.

Resident; abundant; generally distributed throughout all sections, but more plentiful among the heavy timber in the bottom lands. From early morning until the close of day it is busily engaged gathering its insect food from the trunks and branches of the trees. Stomachs of specimens secured contained remains of beetles and larvæ of *Lepidoptera*.

190. TUFTED TITMOUSE.

Parus bicolor Linn.

Resident; abundant. Found everywhere in the forests and orchards, and at all times busily employed searching for insects. They prefer the heavy timber in the valleys. Stomachs of specimens secured contained traces of *Hymenoptera* and *Diptera*, pulp of apple, buds, blackberry and weed seeds.

191. CAROLINA CHICKADEE.

Parus carolinensis Aud.

Resident; common. It is most plentiful along the Ohio Valley. Like other Chickadees it is a lover of woods. Occasion-

ally it may be seen among the orchards. Stomach of specimen secured contained traces of *Hymenoptera*.

192. GOLDEN-CROWNED KINGLET.

Regulus satrapa Licht.

Winter visitant; common. I observed this species in the Ohio Valley October 10, frequenting high open woodlands. Its food consists chiefly of insects. Stomach of specimen secured contain traces of *Diptera*.

193. RUBY-CROWNED KINGLET.

Regulus calendula (Linn.).

Winter visitant; common. I did not find this species until October 24, at Romney, Hampshire County, where it was very common among the tracts of woodland near the South Branch of the Potomac.

194. BLUE-GRAY GNATCATCHER.

Polioptila cærulea (Linn.).

Summer resident; tolerably common. Frequents heavy timber in the valleys. These tiny birds find most of their insect food among the tops of the tallest trees, though they occasionally descend to the ground.

195. WOOD THRUSH.

Turdus mustelinus Gmel.

Summer resident; common; generally found in dense forests and thickets. This species is sometimes call Wood Robin, and can be easily distinguished from the rest of Thrushes, as its upper parts are tawny-brown, brightest on the head. Moreover it is the largest of its genus. It is a charming singer, and may be seen in early evening perched upon the very tip-top of some tall tree close to its favorite resorts, pouring forth its beautiful notes until the last rays of the sinking sun have disappeared behind the western horizon. Its food consists chiefly of insects and berries.

196. WILSON'S THRUSH.

Turdus fuscescens Steph.

Transient visitant; tolerably common. May breed in the mountains. I observed a few of this species among the thickets along the South Branch of the Potomac River October 26.

197. OLIVE-BACKED THRUSH.

Turdus ustulatus swainsonii (Cab.).

Transient visitant. Inserted on the authority of Mr. William Brewster, who records it in his Birds of Ritchie County. I did not meet with it.

198. HERMIT THRUSH.

Turdus aonalaschkæ pallasii (Cab.).

Transient visitant; tolerably common. This is another Thrush I did not meet with. Mr. William Brewster found it in Ritchie County during April and May, where it frequented elevated woods. In this species the upper parts are olivaceous, excepting the tail, which is rufous.

199. ROBIN.

Merula migratoria (Linn.).

Summer resident; abundant. The Robin is one of the most abundant birds in West Virginia, and I have no doubt that many of them remain throughout the winter months in the southern portion of the State, but this, I think, depends entirely on the food supply during that time of year. This species should receive more of the farmers' attention than it does, as it is pre-eminently insectivorous. It occasionally feeds upon fruits, both the wild and cultivated kinds, while they are in season, but this period is short of duration, and during the rest of the year it destroys large numbers of injurious insects. Among wild fruits it feeds upon high blackberry (*Rubus villosus*), wild red raspberry (*R. strigosus*), dewberry (*R. canadensis*), black raspberry (*R. occidentalis*), strawberry (*Fragaria virginiana*), wild black cherry (*Prunus serotina*), and common red cherry (*P. cerasus*), and in autumn it feeds upon the berries of common poke (*Phytolacca decandra*). Stomach of specimen secured contained grasshoppers and a white grub.

200. BLUEBIRD.

Sialia sialis (Linn.).

Summer resident; common. This species is generally distributed, and is the first harbinger of spring. Stomach of specimen secured contained grasshoppers and larvæ of *Lepidoptera*.

BULLETIN NO. 4

OF THE

WEST VIRGINIA

Agricultural Experiment Station

AT

MORGANTOWN, W. VA.,

MARCH, 1889.

The Creamery Industry: Its Adaptability to West Virginia.

BY A. C. MAGRUDER.

JOHN A. MYERS, Director.

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THE CREAMERY INDUSTRY: ITS ADAPTABILITY TO WEST VIRGINIA.

BY A. C. MAGRUDER.

While visiting the different sections of this State in the interest of the Creamery Department of the Experiment Station, my attention has been directed to the natural advantages possessed by the State which adapts it to the Creamery Industry rather than to the present methods of farming.

Within reach of lines of transportation there is scarcely a portion of the cultivated lands of this State one mile square that may not furnish in liberal quantities the three essentials to this industry, viz., good cows, good pastures, and pure water. These three factors have been examined carefully, and I can see no plausible reason why our farmers should prefer to continue in the old and beaten paths.

The arable lands in the greater part of our State are very hilly, and it is with great difficulty in some sections that they are cultivated. Still this system of farming is pursued instead of the much more economic system of converting these steep lands into pastures, with a good cow as the improved machine to convert the grass into milk, a much more marketable product than wheat, corn, or hay.

That our lands can be converted into good pastures is a truth made manifest to us not only by the enterprising farmers of our sister States, who each year are turning the poorer lands into pasture, while only the richer are cropped, but by a few of West Virginia's sons who have seen that cropping the soil year after year without returning plant-food is exhausting the land to such an extent that they are not capable of producing one-half of the crop that was formerly harvested.

Am I too bold in asserting that our bottom lands, as well as the hillsides can be made more remunerative by pasturing and producing butter and cheese than by the present system of

farming, which each year robs the soil of plant food, instead of returning to the soil those elements essential to the best development of plant growth? A comparison of the results of the two systems on a given amount of land for a certain number of years—say ten acres for a decade—will be the most efficient means of substantiating this claim.

The following figures used in estimating the yield and value of wheat and corn are the average of quite a number of estimates made by intelligent and reliable agriculturists of different parts of this State, while those used in estimating the value of creamery products are obtained from the current prices of the day, and are substantiated by experience and experiments in different creameries throughout the country :

Estimated yield and price of wheat per year for ten years:

1st year,	35 bushels per acre,	10 acres,	350 bu.,	at $1 per bu.	$350
2d “	30 “ “	“ “	300 “	“ “ “ “	300
3d “	25 “ “	“ “	250 “	“ “ “ “	250
4th “	20 “ “	“ “	200 “	“ “ “ “	200
5th “	18 “ “	“ “	180 “	“ “ “ “	180
6th “	17 “ “	“ “	170 “	“ “ “ “	170
7th “	16 “ “	“ “	160 “	“ “ “ “	160
8th “	15 “ “	“ “	150 “	“ “ “ “	150
9th “	14 “ “	“ “	140 “	“ “ “ “	140
10th “	13 “ “	“ “	130 “	“ “ “ “	130

The wheat straw sold will have a value of $250.00, giving a total value of $2,280 as gross receipts for the whole crop of ten acres in ten years.

Estimated yield and price of corn per year for ten years :

1st year,	70 bu. per acre,	10 acres,	700 bu.,	at 50 cts. per bu. . . .	$350
2d “	60 “ “	“ “	600 “	“ “ “	300
3d “	50 “ “	“ “	500 “	“ “ “	250
4th “	40 “ “	“ “	400 “	“ “ “	200
5th “	35 “ “	“ “	350 “	“ “ “	175
6th “	30 “ “	“ “	300 “	“ “ “	150
7th “	25 “ “	“ “	250 “	“ “ “	125
8th “	20 “ “	“ “	200 “	“ “ “	100
9th “	20 “ “	“ “	200 “	“ “ “	100
10th “	20 “ “	“ “	200 “	“ “ “	100

Fodder for ten years, equal in value to $300, giving a total

of $2,150 as gross receipts for corn crop of ten acres in ten years.

In the above estimate it will be noticed that wheat is quoted at one dollar and corn at 50 cents per bushel each year for the entire time. While this may have been the case for the last decade, we cannot count on it as a fixed price to be received each year in future, for we are all too well acquainted with the fluctuations of prices which constantly occur.

What can be done on the same ten acres should they be converted into pasture? This amount of land will keep four good dairy cows, and by a good cow we do not have reference to one that gives from two to eight pints of milk per day, but one that will fall very little below the standard, which is as follows:

First three	months	after	becoming	fresh,	3½ gal.	per day,	3 mo.,	315 gal.
Next four	"	"	"	"	2 "	"	4 "	240 "
" three	"	"	"	"	1½ "	"	3 "	135 "
" two	"	"	"	"	0 "	"	2 "	000 "

In twelve months, or one year, she will have produced 690 gallons of milk, which will make 230 pounds of butter, granting that we obtain one pound of butter from every three gallons of milk. The 230 pounds of butter sold at 25 cents per pound, the average price for the creamery product, gives as receipts for butter alone per cow per year $57.50.

1st	year	4 cows	will produce	in butter	920 lbs.,	at 25 cts.	per lb.	$230
2d	"	"	"	"	920	" 25	"	230
3d	"	"	"	"	920	" 25	"	230
4th	"	"	"	"	920	" 25	"	230
5th	"	"	"	"	920	" 25	"	230
6th	"	"	"	"	920	" 25	"	230
7th	"	"	"	"	920	" 25	"	230
8th	"	"	"	"	920	" 25	"	230
9th	"	"	"	"	920	" 25	"	230
10th	"	"	"	"	920	" 25	"	230
								$2,300

From this it will be seen that the four cows would produce in ten years 9,200 pounds of butter, which sold at 25 cents per pound, would amount to $2,300.

Butter is not the only marketable product in milk, for out of every $25\frac{1}{2}$ pounds of whole sweet milk, from which we obtain 1 pound of butter, there remains $21\frac{1}{4}$ pounds of sweet skim milk, when the centrifugal cream separator is used to extract the cream from the milk, the separation being best made while the milk is warm with animal heat. This skim milk being perfectly sweet, may be made into what is known as Schweitzer cheese, but as cheese can be manufactured only from the first of May to the last of October, we must reckon six months in each year, or five years in the ten, to be devoted to the manufacture of cheese from skim milk. Thus only one-half or 977,500 pounds of the skim milk, which would have accumulated in the ten years, can go to the manufacture of cheese. From this amount of milk can be made 8,886.36 pounds of cheese, assuming eleven pounds of milk to one of cheese, which sold at 4 cents per pound would amount to $355.45. From the remaining half of the skim milk can be obtained equally as good results, as experiments have shown that sweet skim milk converted into pork is as remunerative as when made into cheese. In fact, considering the extra expense of a cheese-maker in connection with the business (for certainly one man cannot make both butter and cheese for a creamery from 150 to 400 cows), it is more economical to feed the entire lot of skim milk to hogs than manufacture it into cheese, and then the man who runs the creamery, with little extra labor, can attend to a drove of 100 or 150 hogs.

Let us assume the result obtained by converting the one-half of the skim milk into pork just equal in value to that converted into cheese, though considering the expense of each, results will be much in favor of feeding. We then have twice the amount of the receipts for cheese, or $710.90, as total receipts for skim milk during the decade. From the cream which produced the 9,200 pounds of butter, we obtain 3,737.5 gallons of butter-milk, which valued at only 2 cents per gallon as hog feed (at least 5 cents being obtained when put on the market), we have $74.75 as proceeds from butter-milk in ten years.

From the four cows in ten years may be raised thirty calves, which sold to the butcher, when six weeks old, will have a

value of $5.00 each, giving for the entire lot a value of $150.00. From this $150.00 we must deduct the price of the milk used in rearing these calves. Assuming that each will consume two gallons of skim milk per day, equal in estimated value to four cents, we have for thirty calves, forty-two days, 2,520 gallons of milk at 2 cents per gallon, $50.40, deducted from $150.00 leaves $99.60 as value of calves.

The four cows will have produced in ten years :

9,200 lbs. of butter, at 25 cents per lb.	$2,300 00
8,886.36 lbs. of cheese, at 4 cents per lb.	355 45
12,218.75 gals. of skim milk	355 45
373.75 gals. butter-milk, at 2 cents per gal	74 75
Calf flesh	99 60
	$3,185 25

Giving as the gross receipts for the four cows on ten acres for ten years $3,185.25, which is $923.25 greater than gross receipts for wheat and $1,053.25 greater than gross receipts for corn for the same time. This increase in the marketable produce of the two systems of farming is very apparent, while the increase of nutritive matter in the soil is no less apparent, for at the end of the decade the cropped soil will hardly produce ten bushels of wheat or twenty bushels of corn per acre, while that which has been pastured, if all the manure has been judiciously applied to the farm, has accumulated a treasure of fertilizer which may enable the farmer to harvest from 70 to 80 bushels of corn and from 40 to 50 bushels of wheat per acre.

The amount of manure produced during these ten years is no trifling item, as its market value would almost pay each year for the winter's food. It has been asserted that the manure pile is the farmer's saving bank, and a greater truism has never been uttered. This means that if all the animal excrement were collected and properly used it would be a matter of only a few years until our farmers could live in luxury on the same land that would scarcely supply food and raiment where no attention is paid to the application of manure to the land to increase the harvest. Too much stress cannot be laid upon this. The fertilizer obtained from the dairy herd is of far greater value

than is commonly supposed. Of so much value has animal excrement become that in some sections men use their live stock as machines to convert hay, straw, etc., into manure. Certainly if this is found to be a profitable business alone how much more profitable would it be should we engage in the creamery industry, save all the manure, apply it to our farms to enhance their value, and at the same time reap our principal harvest from the milk sold.

It is to be hoped that by a careful study of this comparison our farmers' eyes may be opened to what they can do if they would utilize nature's gifts.

HOW CAN WE CONVERT OUR LANDS INTO PASTURES?

This cannot be done at once, but the poor land of the farm by lying uncultivated while the better lands are being cropped will become covered with a sod of our natural grasses, which we claim are as fine as can be found in almost any section of these United States. Blue grass, the great pasture sod, is as luxuriant on our soil as it is in its native home, and with this grass we are able to successfully compete with the creamery industry in other sections of the country.

Our rivers, creeks, and springs furnish an abundance of the purest water that can be found, and this, combined with our blue grass pastures, together with the grade of cattle that we already possess, is all that is necessary to make the creamery business more remunerative than any other system of farming that can be adopted.

Great interest has been manifested in the subject of butter and cheese manufacture wherever I have talked with the people upon this subject. There are many who are beginning to see that their cows, by grazing these steep West Virginia lands, can bring in more money each year than any other system by which these lands may be utilized. We believe that if every farmer in this State could be made to know this truth he would appreciate its advantages, and this prompts us to place the subject as plainly as possible before them, that each may study the comparison and decide if he will engage in a more profitable business than he now pursues.

One other point should be observed before a decision is made. Near the larger cities, on land worth from $100 to $150 per acre, the creamery industry is found to pay better than any other system of farming. Why can not we with our fine pasture lands make this our vocation?

In order that as much light as possible may be thrown upon the subject, we give below a complete list of apparatus of a creamery for manufacturing the milk of from 100 to 200 cows, and also for a creamery with a capacity to manufacture the milk of from 200 to 500 cows—the lists differing on account of apparatus of larger capacity being required in the larger creamery and extras, such as hoisting crane, etc., being necessary in handling the larger quantities of milk.

Together with this list is a plan for a creamery building, with specifications so detailed that any ordinary carpenter can erect the building with little trouble, as all the material to be used is specified. Of course, no one is expected to be guided exclusively by these plans or specifications; they will, however, serve to give the correct idea of what is required in the construction, the structure being modified to suit the circumstances of a community. Parts of these specifications may be omitted in building, everything not being strictly necessary, and as such things as transoms, three coats of paint, oiling on the inside, tin roofing, etc., are done away with, the cost will be materially decreased, enabling one to erect a building for from $300 to $500 that is in every respect suitable for carrying on the business in the most improved style.

The apparatus given in the list may be obtained from any of the firms dealing in dairy fixtures, which are to be found throughout the country, while checks, shipping-tags, and such may be printed at the office of your town or county paper.

It will be remembered that the prices as quoted for the different articles are taken from catalogues, and in purchasing outfit there is always a discount of from ten to thirty per cent. allowed. This per cent. off will decrease the cost of outfit as given in the estimate.

	Large Capacity.	Small Capacity.
1 centrifugal cream separator	$285 00	$285 00
1 churn, 300 gal	40 00	40 00
1 engine, 6 H. P., and boiler, 8 H. P	300 00	300 00
1 milk-testing outfit....................	12 00	12 00
1 butter-worker—power; hand	50 00	25 00
1 butter print	10 00	10 00
1 set hoisting-crane fixtures............	7 00	
1 pair scales—7 beam; 5 beam	35 00	30 00
1 pair scales—platform	20 00	20 00
1 receiving-tank—100 gal.; 80 gal	15 00	12 00
1 milk conductor	1 75	
1 dipper, 1 gal	75	75
1 graduate, 8 oz	60	60
6 thermometers, floating...............	2 00	2 00
2 mops, rubber	80	80
2 vat scrub brushes	80	80
1 butter tray, 100 pounds capacity......	3 50	
1 butter tray, 75 pounds capacity.......	3 00	3 00
3 butter trays, 50 pounds capacity	7 50	7 50
2 factory ladles, large	1 00	1 00
2 factory ladles, medium	80	80
1 butter packer	75	75
1 butter spade	50	50
2 sieves, hair	1 00	1 00
1 sack salt, dairy	2 50	2 50
1 gal. butter coloring	2 75	2 75
2 cream cans, 30 gal. capacity..........	15 00	15 00
2 cream cans, 40 gal. capacity..........	18 00	18 00
4 shipping butter boxes, 20 lbs. capacity.	16 00	16 00
4 shipping butter boxes, 40 lbs. capacity.	20 00	20 00
1 milk ledger	75	75
1 bolt butter cloth	5 00	5 00
1 dozen ash tubs, 40 pounds capacity ...	3 36	3 36
1 dozen ash tubs, 20 pounds capacity ...	3 00	3 00
1 dozen ash tubs, 60 pounds capacity ...	4 00	4 00
6 buckets, 3 gal., iron-clad.............	6 00	6 00
1 gal. sperm oil......................	2 00	2 00

	Large Capacity.	Small Capacity.
1 gal. machine oil	$1 00	$1 00
1 broom	35	35
50 ft. hose, 1-inch rubber	10 00	10 00
20 ft. shafting, 1½-inch (a)	15 00	15 00
100 ft. belting (b)	30 00	30 00
*1 pulley, 3½-in. face, 20-in. in diam. (c) .	7 00	7 00
1 pulley, 3½-in. face, 16 in. in diam. (d)..	6 00	
1 pulley, 8-in. face, 6 in. in diam	4 00	4 00
1 pulley (e)	7 00	7 00
1,000 milk checks, as per sample	5 00	5 00
1,000 shipping tags, as per sample	5 00	5 00
1 creamery building	500 00	300 00
	$1,487 46	$1,236 21

The separator given in the above list is a machine which is new to many of us, and an explanation of its work will best show its use in the creamery. It consists of a steel bowl 12 inches in

The Driving Shaft in connection with Pulley.—The pulley on the shaft driving the Intermediate should be 3½ inches wide, and have crowned face. The required diameter of this pulley is ascertained as follows: Multiply the diameter of small pulley on the Intermediate (3½ inches) by the number of revolutions per minute the Intermediate shall make (1,050 revolutions for steam power, or 975 revolutions for horse power), and divide the product by the number of revolutions the driving shaft is found to make.

The following table shows the diameter required of the driving pulley at several different speeds of the shaft to secure proper speed of the Separator and Intermediate for both steam and horse power:

SPEED OF DRIVING SHAFT. (Revolutions per Minute.)									SPEED OF INTERMEDIATE.	SPEED OF SEPARATOR.
100	125	150	175	200	225	250	275	300		
DIAMETER OF DRIVING PULLEY IN INCHES.										
34	27	23	20	17	15	14	12	11	975 rev. per min.	7,500 rev. per min.
37	29	25	21	18	16	15	14	12	1050 rev. per min.	6,000 rev. per min.

diameter, having connected with it on the under side a spindle 15 inches long, which fits into a cup-like piece of steel. This spindle of the bowl is connected with the engine by means of a system of pulleys and belts so that a velocity of 6,500 revolutions per minute is obtained. The warm milk is made to flow into the bowl through the opening in the top when the bowl has acquired the required number of revolutions. The rapid revolution of the separator throws the cream to the center of the bowl, while the milk is walled up against the inside. Proper outlets are provided by which the cream and milk pass out in separate streams to pans provided with spouts, which convey the cream to one vessel and the skim milk to the other. The principle on which the machine works is not new, as it is centrifugal force, but this application of it to separating cream from milk is recent.

By the use of this machine the milk may be freed of its cream at the rate of 100 gallons per hour, leaving both cream and skim milk in a perfectly sweet condition.

This process enables the cream to be taken from the milk immediately, without having to wait from 12 to 36 hours, as is necessary with any other system. The skim milk, being destitute of all cream, is either taken home (the cream only being left at the creamery) and there utilized to the best advantage or left at the creamery to be converted either into cheese or pork.

A system of checks is used at the creamery, which enables both patron and creamery man to keep a correct account of the number of pounds of milk delivered. The check is perforated across the center, the upper and lower sides being filled out in exactly the same manner. For instance, the check represents A. B. as having delivered on the morning of January 1st, 1889, 350 pounds of milk. The check is torn in two at the center—one half being given to the patron, while the other is filed at the creamery for reference.

Date, January 1st, 1889.

Name, A. B.

No. of pounds, 350

Date, January 1st, 1889.

Name, A. B.

No. of pounds, 350.

Of course the milk ledger, which is properly ruled, contains the number of pounds of milk delivered by each patron each day. At the end of the month the patrons add the number of pounds on their checks to see that no mistake is made at the creamery. This system has been adopted as the best means of keeping accurately each man's account.

The shipping tag, to which we alluded in the foregoing list, is only for butter boxes, etc., which are shipped to the markets. It is arranged as follows:

To

F. H. J. & Co.,

Washington, D. C.

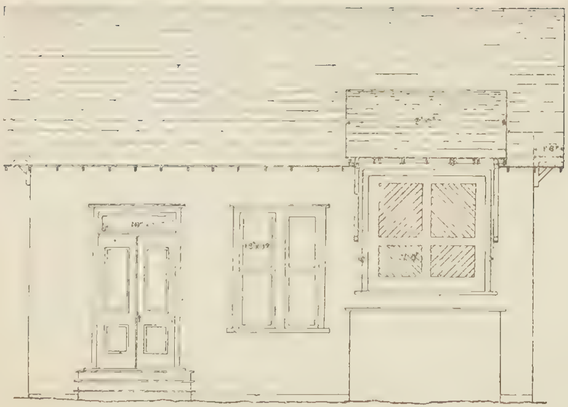
Net 60 *Gross* 68

From

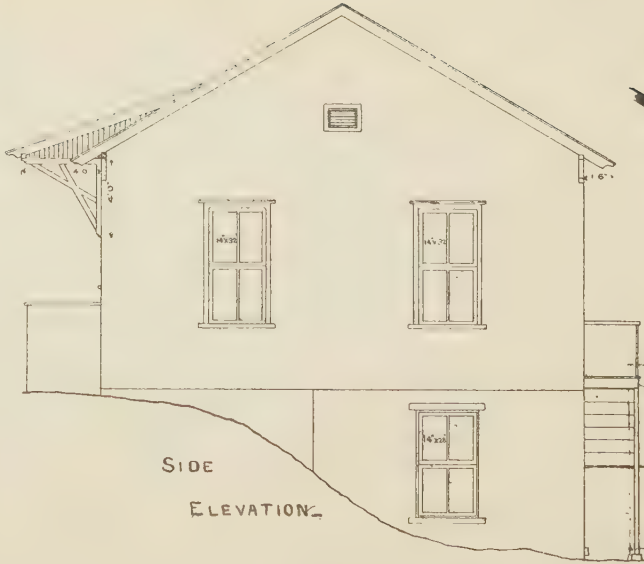
EXPERIMENT STATION CREAMERY,

Morgantown, W. Va.

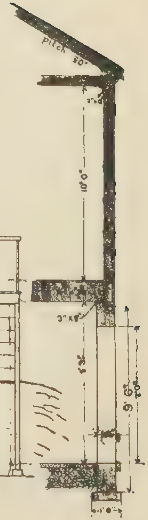
The cuts on following page give both front and side elevation of building: specifications which follow will guide as to dimensions.



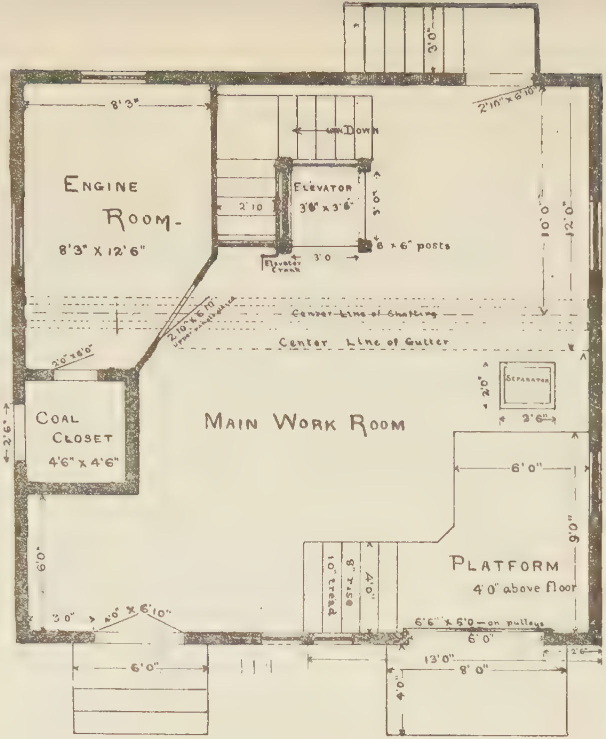
FRONT ELEVATION



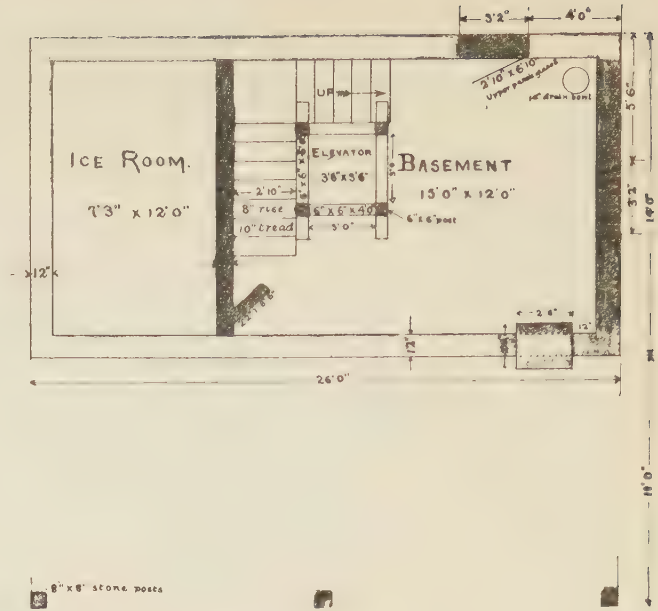
SIDE ELEVATION



SECTION

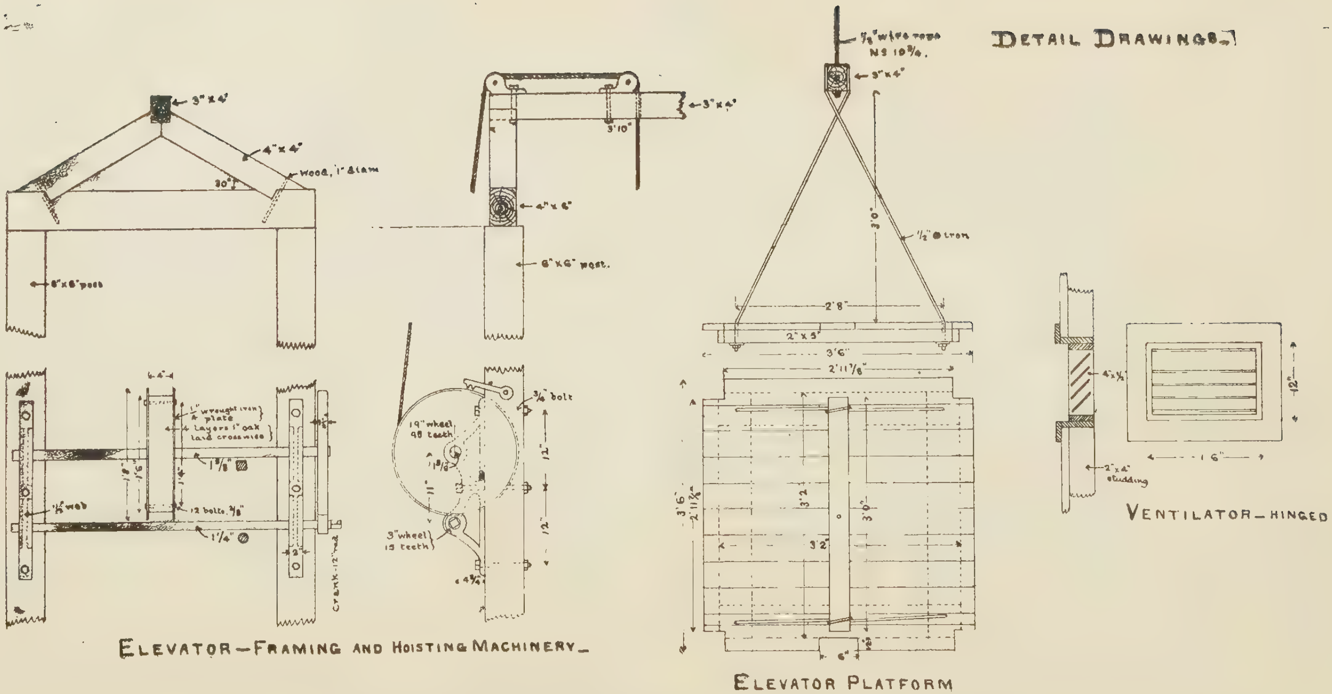


MAIN FLOOR PLAN.



BASEMENT PLAN.

Main floor and basement plan, showing position of separator, churn, elevator, stairs, etc.



Cuts showing Elevator, hoisting machinery, and ventilators.

SPECIFICATIONS.

GENERAL.

These plans and specifications are supplementary, and anything drawn or described in either will be considered as part of the contract. Written dimensions will govern measurements on plans, but measurements may be taken provided the required dimensions are not given in either plans or specifications. All workmanship must be perfect and the materials first class of their kinds as specified.

EXCAVATION.

Excavate under the basement to 9′ 3″ under required level of top of foundation wall—to 10 feet, under walls of basement. No excavation under front of building, except for foundation stones, which shall be 8″ square and long enough to be sunk 2′6″ under ground. All these foundations shall be constructed even deeper than here specified should the nature of the soil at these depths prove too insecure for a firm foundation. A 3-inch tile drain with fall of 1 inch in 50 shall be laid from the bottom of the basement to a point where it shall have free out-flow.

MASONRY.

A footing course 18″ wide and at least 4″ thick shall be laid under all masonry walls. The walls shall be stone rubble, 12″ thick, laid in a mortar composed of 1 part freshly burnt lime, 1 part hydraulic cement and 8 parts of clean sharp sand. The 9-inch partition wall between the ice room and basement shall be of brick. The bottom of the ice room and basement shall have a layer of small stones and gravel 12″ thick, the stones being placed on the bottom. This shall be overlaid with a 3″ layer of concrete composed of 1 part hydraulic cement and 3 parts sand, the floor surface being dressed off smooth. The basement floor shall slope toward the corner where the drain bowl is, where the floor shall be 3″ lower than the opposite diagonal corner of

the basement. The floor of the ice room shall slope toward the door.

The foundation for the "Separator" shall be a single stone 2′ 0″ x 2′ 6″ x 0′ 8″. The sides of this stone projecting over the 12″ wall to be braced by corbels built into the wall immediately underneath. This stone (*perfectly level on top*) to be at height of main floor.

The walls of the ice room and basement to be plastered directly on the masonry ; two coat work ; both coats containing 10% cement.

CARPENTRY—FRAMING.

All framing to be of poplar or hemlock, except as particularly specified. Sills, under front part, 6″ x 8″; under back part, 3″ x 8″. Studding, 2″ x 4″. Corner posts, 4″ x 4″. Plates, 2 pieces, 2″ x 4″. Girts, oak, 1″ x 6″. Floor joists for main floor, oak, 2″ x 12″ spaced 18″ on centers. Ceiling rafters, 2″ x 5″, spaced 16″ on centers. Roof rafters, 2″ x 5″, spaced 16″ on centers.

FLOORING.

The joists under the engine and engine room to be doubled. The floor to be sloped from front and back toward the gutter through the center of the building. The gutter at A (see Main Floor Plan) to be 4″ lower than the floor level at front and back and 2″ lower than the other end of the gutter. The floor to be laid with ⅞″ oak, matched and dressed. The attic floor to be covered with rough hemlock or poplar boarding 1″ thick for a width of 10 feet under the ridge of the roof. Joists doubled under "Intermediate" (directly back of " Separator ").

SIDING.

The outside walls to be covered with ⅞″ poplar siding. The outside corners to be cased with 4″ poplar casing and a 6″ plancher shall be placed under the eaves front and back.

CEILING AND INSIDE WALLS.

The ceiling and inside walls shall be ceiled with narrow, beaded, tongued and grooved, ⅝″ poplar, not more than 3″

wide. The walls of the coal room to have only rough poplar or hemlock boards, 1″ thick, nailed to the studding to height of 6 feet above the floor. The partition between the engine-room and main work-room to be made by laying ceiling stuff on a frame-work of dressed poplar made of 1″ x 3″ stuff into panels about 3 feet square. All corners between floor and walls, between adjacent walls and between walls and ceiling to be filled with quarter-round 1″ nosing.

DOORS.

All doors except the two doors in the front to be $1\frac{3}{8}$″, flat-panel doors of sizes as shown on plans. The main front door to be double—$1\frac{3}{4}$″ thick—panels moulded on the outside—transom above. The sliding door on platform to be made of design as shown on front elevation; its framing $1\frac{3}{4}$″ thick, the paneling $\frac{7}{8}$ thick, sunk into framing so as to be flush on the inside; to be hung on pulleys running on rail overhead; to have a hook and staple for fastening it closed. All swinging doors to be provided with hinges, key locks and bronze knobs, two of them (as indicated on plans) having the upper panels glazed.

The door to the ice room to be 6″ thick, made by securing to an ordinary door a box filled with perfectly dry sawdust, the door itself forming one face of the box. The box to be made of 1″ dressed poplar. The top, bottom, and handle side of the door to be beveled so as to swing into its frame easily, which is to be beveled correspondingly. This door to be swung on three heavy 6-inch strap hinges and to be provided with a bolt for fastening it when closed. A simple handle for pulling the door open shall also be provided.

All door and window frames shall be cased both inside and outside.

WINDOWS.

Glass of sizes as shown on plans, and sashes and frames to correspond. Windows to be hung with weights and pulleys and provided with proper fastenings. The large double window in front is really two single independent windows placed so as to allow just room enough for the weight boxes between them. The window to the coal room (2′ 6″ wide and 2′ 0″

high, its sill 5′ 0″ above the floor) to be closed by a shutter, swinging in and hung at the top, provided with hinges, a bolt to fasten it when closed and a hook to keep it open.

There shall be a ventilator (see detail drawings) in each gable end, 18″ wide and 12″ high, made by placing within simple box frame horizontal slats 4″ wide, $\frac{1}{2}$″ thick, placed 2″ apart, and sloping outward and at an angle of 45°. This box frame shall be hung on hinges at the side, and so made (slightly beveled at the side) that it may be swung open. To be provided with a hook to fasten it when closed.

ROOF.

The first two pairs of rafters at each end shall be exposed underneath, also the overhanging ends of all the others. The first pair of rafters at each are supported by a pair of brackets 18″ x 18″ made (as shown on front elevation) of 3″ x 3″ poplar. The projecting roof over the platform shall be supported by two brackets 4′ 0″ x 4′ 0″ made (as shown in side elevation) of 4″ x 4″ poplar, and placed 7′ 0″ apart, on each side of the doorway. The rafters of this projecting roof shall be supported (on the front end) by a piece of poplar 4″ x 4″ x 8′ 0″, which shall rest on the front ends of the two large brackets. The two end rafters of this projecting roof shall be 4″ x 5″ section and shall rest directly above the brackets, the other five being spaced equally between these two. The rafters on the main roof corresponding to these shall be directly underneath them and shall not overhang the wall line. The second rafter from each end of the main roof shall be close against the end walls (taking the place of a plancher). Between the rafter at the right end of the building and the one at the right end of the projecting roof there shall be 12 rafters equally spaced—the interval from center to center will be about 15$\frac{1}{3}$ inches. At the left end of the building, there shall be one rafter between the one at the wall line and the end rafter of the projecting roof. The extreme end rafters shall have the same interval (15$\frac{1}{3}$ inches) from the rafters at the wall line. The roof shall be sheathed with $\frac{7}{8}$″ poplar sheathing. All exposed wood-work (the overhanging ends of the rafters, the two pairs of rafters at each end and the sheathing under the eaves) shall be dressed smooth.

The under side of the platform roof shall be ceiled with $\frac{5}{8}''$ narrow, beaded, tongued and grooved poplar, just above the level of the brackets. The space between the brackets and the rafters immediately above them (see side elevation) shall be filled with the same ceiling material.

STAIRS.

All stairs and steps to be built with 8″ rise and 10″ tread. Stringers, treads and risers of oak. Treads, $1\frac{1}{8}''$ thick; risers, $\frac{7}{8}''$ thick; stringers, $1\frac{1}{4}''$ thick. The front steps to be trimmed and cased with poplar. A plain guard rail, 2″ x 4″, with plain supports, shall be provided for the back steps. A plain poplar guard rail shall also be placed between the posts of the elevator where adjacent to the main stairs. The stringers of the main stairs next to the elevator may be supported by securing them to the elevator posts.

PLATFORMS.

Both inside and outside platforms to be built of 2″ x 5″ joists resting on 3″ x 6″ girders on the outside end and on 1″ x 6″ girts nailed to the studding on the wall end. The girders shall be supported by 4″ x 4″ posts placed at the corners. The flooring of platforms same as that of main floor. The inside platform to be cased with $\frac{5}{8}''$ poplar ceiling stuff. The outside platform to be cased with 1″ poplar.

ELEVATOR.

Its foundation shall consist of two pieces 6″ x 6″ x 6′ 0″ resting on the concrete floor and made perfectly level. Resting on these, at right angles to them and connecting them, shall be two pieces 6″ x 6″ x 4′ 0″. The posts resting on this foundation shall be 6″ x 6″ x 21′ 0″ extending about 2 feet above the attic floor. At the tops there shall be a pair of trusses (see detail drawings) connected by a piece 3″ x 4″ x 4′ 0″. The trusses run front and back as to the building. All this framing of oak. The floor joists and ceiling rafters to be secured to this framing so that they will be mutually braced.

The wire rope from elevator platform shall come up through the cross piece at its middle, over an iron pulley placed there then to end of cross-piece, over another pulley there, and then

down outside the elevator to a drum revolving with an axle whose bearings are secured to two of the elevator posts. The axle to be provided with crank, ratchet and pawl.

The elevator platform to be built of floor boarding screwed to a framing of 2″ x 5″ oak. The platform to have at each end a hanger of ½″ round iron. These hangers to be connected at top by a cross-piece (3″ x 4″ x 3′ 0″) to the center of which is fastened the wire rope, which shall be ½″ diameter. The corners of the elevator platform (3′ 6″ x 3′ 6″) shall be notched so as to slide between the elevator posts as guides.

FRAMING FOR SHAFTING.

In the side walls of the main floor at each end of the line of shafting, there shall be two oak posts built into the wall, each 4″ x 6″ section, the 6″ side at right angles to the wall. Resting on these and immediately under the ceiling rafters there shall be two oak girders 4″ x 6″ (the 6″ side vertical), the pulley hangers being secured to these girders. These girders shall be 12″ between centers.

CHURN POSTS.

There shall be two vertical oak posts, 4″ x 6″, extending from floor to ceiling and properly secured, placed wherever it may be directed, to which the revolving churn shall be hung.

TINNING.

The roof shall be tinned with charcoal tin, standing joints. Gutters and leaders shall be provided for the eaves on the rear and the eaves on the front above the front door and window.

The gutter on the floor of the main work-room shall have a galvanized iron lining extending 12 inches each side of the center line of the gutter. The edges shall be tacked very closely and tightly and then made water-tight with oil and putty. At the lower end of the gutter (at A on the plan) a 3-inch tin pipe shall be let through the wall and continued down the outside to the ground where it will empty into a 3-inch tile drain pipe (which also connects with the drain bowl in basement) which will be run out to some point at least 25 feet from the building, where it shall have free out-flow. The

inside of the wall shall be flashed for 6″ around this outlet pipe with tin.

A sheet of heavy galvanized iron, 5′ 0″ x 6′ 0″, shall be placed under and in front of the fire-box of the engine.

The sheet-iron smoke-stack of the engine shall be carried straight up through the ceiling and roof, which must be cut out so that no wood-work shall be closer than 3″ to the stack. The anular openings thus made shall be filled with sheet-iron. The stack is to be surmounted by a sheet-iron cap.

PAINTING, OILING, &C.

All the outside wood-work shall be painted three coats good quality lead paint in any three colors that may be selected. All knots to be filled with shellac before painting. The roof shall be painted on both sides with mineral paint.

All the inside wood-work, except in the attic and coal room, to be oiled with two coats of boiled linseed oil.

SEPARATOR.

The foundation stone of the separator shall have bolt holes bored through it at places corresponding to the holes in the iron base of the machine. The bolts, with their heads at the under side of the stone, shall be placed in position when the stone is set.

ENGINE AND BOILER.

The engine and boiler had best be of the horizontal type, six-horse power, with the engine placed on top of the boiler.

BILL OF MATERIALS.

The following bill of materials has been made out with special reference to the erection of this building at a proposed site at Morgantown, W. Va. Note will be made, however, of the changes necessitated in this bill in order to adapt it to any locality. A mark will be made against each item whose amount varies with the locality.

MASONRY, EXCAVATION, &c.

25.6 cu. yds. stone rubble, 12″ thick..... ....
87 lin. ft. footings, 1′ 6″ wide, at least 4″ thick ....
$2\frac{3}{4}$ cu. yds. brick, (in 9″ partition wall)... ......
1 door cap, 1 window cap and sill, each 4″ x 12″ x 4′ 0″.... .. ..
1 door sill, 8″ x 12″ x 4′ 0″............ ......
3 foundation stones, 8″ x 8″ x 3′ 0″ (sometimes longer) .. ..
1 stone, 2′ 0″ x 2′ 6″ x 0′ 8″ (foundation for separator)..... .. . .
Tile drain, 3″ diam., (length variable).... .. ...
Excavation, about 60 cu. yds. at University, maximum about 110 cu. yds .. ..
10.3 cu. yds sand and coarse gravel for basement floor ....
2.6 cu. yds. concrete for basement floor .. ..
79 sq. yds. plastering, 2 coat work ....
1 drain bowl, 14″ diam., set in basement.........

LUMBER.

	ft. b. m.
2 sills, 3″ x 8″ x 26′ 0″.......	52
2 " x 25′ 0″	50
36 studs, 2″ x 4″ x 11′ 8″	280
34 " x 13′ 0″ to 19′ 3″..........	363
9 " x 10′ 0″	60
4 corner posts, 4″ x 4″ x 11′ 8″	62
4 plates, 2″ x 4″ x 26′ 0″	69
20 ceiling rafters, 2″ x 5″ x 25′ 0″..........	417
41 roof " x 16′ 3″..........	555
7 " " x 14′ 9″..........	86
5 " " x 10′ 6″..........	44
2 " " 4″ x 5″ x 10′ 6″..........	17
1 beam, 4″ x 4″ x 8′ 0″ (on front brackets).	11
Poplar lumber	2,066
19 joists, 2″ x 12″ x 13′ 6″...................	513
20 " x 13′ 0″	520

4 joists 2″ x 12″ x 6′ 0″	48
2 ″ x 6′ 6″	26
2 girts, 1″ x 6″ x 25′ 0″	25
2 ″ x 24′ 0″	24
1 ″ x 8′ 6″	4
1 ″ x 9′ 0″	5
1 ″ x 7′ 8″	4
Inside platform—	
6 joists, 2″ x 5″ x 3′ 10″	19
5 ″ x 5′ 10″	24
1 girder, 3″ x 6″ x 8′ 6″	13
1 ″ x 5′ 0″	8
3 posts, 4″ x 4″ x 3′ 0″	12
Outside platform—	
7 joists, 2″ x 5″ x 3′ 9″	22
1 girder, 3″ x 6″ x 7′ 8″	12
2 posts, 4″ x 4″ x 3′ 6″	9
Elevator—	
2 sills, 6″ x 6″ x 6′ 0″	36
2 ″ x 4′ 0″	24
4 posts, 6″ x 6″ x 21′ 0″	252
2 beams, 4″ x 6″ x 4′ 0″	16
4 ″ 4″ x 4″ x 2′ 0″	11
1 ″ 3″ x 4″ x 4′ 0″	4
1 ″ x 3′ 0″	3
Shafting—	
4 posts, 6″ x 4″ x 10′ 7½″	85
2 girders, 25′ 10″	103
Churn posts—	
2 posts, 6″ x 4″ x 10′ 0″	40
Oak lumber	1,862

2 brackets, 1′ 6″ x 1′ 6″, made of 3″ x 3″ poplar (see front elevation) ....

2 brackets, 4′ 0″ x 4′ 0″, made of 4″ x 4″ poplar (see side elevation) ....

672 ft. b. m. flooring, ⅞″ oak (including both platforms) ....

1,558 sq. ft. $\frac{5}{8}''$ poplar ceiling........ .....
1,274 ft. b. m. $\frac{7}{8}''$ poplar siding.............
993 ft. b. m. sheathing for roof ($\frac{7}{8}''$ poplar)..
252 lin. ft. 1 inch quarter-round nosing.....
116 lin ft. 1'' x 3'' poplar for partition of engine-room... ....
17 lin. ft. poplar for guard-rail, 2'' x 3'', main stairs........... ....
91 ft. b. m. rough 1'' poplar for lining coal-room ... .
23 ft. b. m. oak in elevator platform........

DOORS

(with frames and casings.)

1 pair doors, 4′ 0′′ x 6′ 10′′ x $1\frac{3}{4}''$ with 14 transom ....
1 sliding door, 6′ 6′′ x 6′ 0′′............ ...
2 doors, 2′ 10′′ x 6′ 10′′ x $1\frac{5}{8}''$, O. G. flat-panel, upper panels glazed.... ....
1 door, 2′ 10′′ x 6′ 10′′ x $1\frac{5}{8}''$ O. G. flat-panel
1 " 2′ 0′′ x 6′ 0′′ x $1\frac{3}{8}''$, " "
1 " 2′ 2′′ x 6′ 6′′ x $1\frac{5}{8}''$, O. G. flat-panel for ice-room. About 32 ft. b. m. of 1′′ poplar will be required for the completion of this door and its frame..................
1 shutter to coal-room, 2′ 6′′ wide, 2′ 0′′ high, swung at top, requiring about 8 ft. b. m..

WINDOWS

(with frames and casings.)

4 windows, 4 panes, 14′′ x 32′′, weights and pulleys.......... ....
1 window, 4 panes, 14′′ x 28′′, weights and pulleys.......... ....
2 windows, 4 panes, 18′′ x 32′′, weights and pulleys ....
2 ventilator windows, 12′′ x 18′′ (as per specifications and detailed drawings) ....

STAIRS AND STEPS.

Main stairs—

	ft. b. m.
12 treads, 2′ 10″ x 0′ 11″ x $1\frac{1}{8}$″	35
14 risers, 2′ 10″ x 0′ 8″ x $\frac{7}{8}$″	23
1 platform, 2′ 10″ x 2′ 10″ x $1\frac{1}{8}$″	9
Stringers, $1\frac{1}{2}$″ thick, 3 rows	60
Framing to support stair platform, 2″ x 6″	16
	143
Front steps (about)	80
Poplar casing for outside platform "	72
Steps to inside platform "	68
Back steps (variable according to locality) (about)	70

TINNING.

9.93 sq. of tinning ....

43 lin. ft. "stop" gutter....................

37 lin. ft. 3″ leaders ....

38 sq. ft. sheet-iron lining to gutter on main floor....................

1 sheet heavy galvanized-iron 5′ x 6′........

1 sheet iron flue-cap to 8″ flue............

12 feet (about) 8″ sheet-iron flue for engine.

HARDWARE.

300 lbs. common nails....................

50 lbs. finishing nails....................

3 pairs bronze butts, 4″ x 4″, for front doors

4 pairs iron butts, $3\frac{1}{2}$″ x $3\frac{1}{2}$″, for other doors

3 strap-hinges, 6″, for ice-room door........

3 pair butts, 2″ x 2″, for coal-room shutter and ventilators....................

1 mortise-lock, 5″, for front door..........

1 flush-bolt, for front door ....

4 rim-locks, with keys, $4\frac{1}{2}$″, for other doors..

1 set sheaves and 13 ft. rail, for sliding doors

2 common iron bolts, for ice-room door and coal-room shutter....................

1 iron ring, 3″ diam., with bolt staple, for ice-room-door . . . .
4 iron hooks and staples . . . .
7 window-fasteners . . . .

SITUATION OF CREAMERY.

Building to be built at such place as may be indicated.

REMARKS ON SPECIFICATION.

It will be remembered, by those using these specifications, that they were made with reference to erecting a creamery at our station; but the great demand from all parts of the State for plans of creamery building has prompted us to give, in this bulletin, things that will answer the many inquiries coming from the people.

Should any community or company let the work of building to contractors, they will find it to their interests to use some set of specifications; the main points of which may be obtained from those given.

EXCAVATION.

In following the specifications given in regard to excavation, the parties will be governed by the situation of the building. It has been found more economical to build on the side of a hill, that as little work as possible may be done in excavating for basement; the amount of earth to be removed depending on the slope of the hill.

MASONRY.

Stone may be used in the nine-inch partition wall between ice-room and basement. Should it be cheaper in making floor of basement rooms, it is not necessary for the stone, gravel, etc., forming floor, to be over eight inches thick unless the earth is inclined to be wet and seepy. If walls in basement are built with care, making a comparatively smooth surface, no plastering will be necessary except where there is a tendency for water to seep in through the wall.

FRAMING.

One's own judgment will prompt him to use in framing, whatever kind of timber is best suited to his locality.

FLOORING.

Specifications should be fully carried out, as all things are essential.

SIDING.

May be carried out to suit those having work done.

CEILING AND INSIDE WALLS.

Common six-inch tongued and grooved ceiling may be used for both ceiling and inside wall. The partition between engine-room and main work-room may be of same material as is used in ceiling, the plank running perpendicularly to the floor.

DOORS.

All doors may be of the same material as is ordinarily used in buildings, with no extra timber of any sort, and locks may be of the common kind.

WINDOWS.

Weights and pulleys may be omitted. The double window in front may be made into one large window should it be found to be less expensive.

TRANSOMS.

May or may not be used.

ELEVATOR.

The construction of elevator will be essentially the same as shown on plans. It will be found to better advantage if one-half inch cotton rope is used in place of the wire as specified.

TINNING.

All tinning on roof may be omitted should it be found to be more economical to use other material that will answer the purpose.

PAINT.

May be omitted or as much used as will be necessary for preservation.

SITUATION.

Building should be centrally located in reference to patrons

supplying the milk, but care must be taken in all cases to see that a sufficient supply of pure spring or well water can be obtained at the creamery. To a certain extent the site of building will be governed by the water supply and the central location must be sacrificed if water supply can not be obtained.

BILL OF MATERIALS.

The changes that may be made in this building will necessarily affect the bill of materials as given, and due notice should be taken of any changes made, and the bill altered to suit the change.

HOW CREAMERIES ARE CONDUCTED.

A creamery may be conducted either on the co-operative plan or as a private enterprise. In the former case, the farmers erect the building ; supply the necessary apparatus, and pay all expenses that they may have a place for manufacturing their produce to be sent to the markets in a form that it will command the highest price. In the latter case, the creamery is owned by a firm who buy the milk from the farmers, paying them a higher or lower price per pound, as the butter market rises or falls. In either case, the farmers deliver their milk twice a day in warm weather and once a day (in the morning) when the milk can be kept over night without becoming sour.

In the former plan (co-operative), there is no middle man to be remunerated for his services as proprietor, but all proceeds, after paying running expenses, go direct to the farmers who furnish the milk; while in the latter case, a part of the returns must be used in paying this middle man.

There is a certain rivalry in dairy sections that is almost the life of the business. Every one is engaged in supplying more or less milk to the creamery; hence, each tries to beat his neighbor in both quality and quantity of the product from his cows. A gain one month over the last inspires one for greater gain and the cows will be milked until the last drop that has been produced has been extracted from the udder.

The monthly settlement is one of the greatest points in favor of the creamery business. Instead of having to wait six months or a year for proceeds of the work, as is the case in other styles

of farming, a settlement is made at the end of each month, enabling the farmers to receive the reward of their labor at short intervals. On settlement day it will be found that two men may have milked the same number of cows, still the two yields will be very different for the thirty days past. Another point may be noticed, that the man who had delivered the smaller number of pounds of milk may have credit for the greater number of pounds of butter.

MODE AND VALUE OF TESTING.

The part of the routine work known as "testing" is of the utmost importance as it determines the butter value of each man's milk, and according to the test is each man paid for his milk.

It was stated that though two patrons may deliver the same amount of milk, the butter yield of the one might be double that of the other. This difference in quality is determined by the creamery man who subjects a fair sample of each man's milk to a test once in every two days. An example will best explain the value of testing.

A delivered during the month of January 3,000 pounds of milk. About twelve different tests were taken during the time to get at the quality of his milk. Milk is not necessarily of the same richness two days in succession, and one day it may take 26 pounds of milk to make one pound of butter and the next it may take 22, the next 24 and so on through the month. At the end of the month an average is taken of all the tests and it is found to take say 24 pounds of milk to one of butter. 3,000 pounds of milk were delivered during the month and 24 pounds are required to make one pound of butter; hence, according to test yield, A should receive payment for 125 pounds of butter.

In testing small quantities of milk, we are more apt to get at exactly the amount of butter-fat contained than when large quantities are churned; or rather I should say that when large quantities of cream are churned we cannot get out all the butter that it contains; hence, the actual yield or the aggregate of all the butter made in the creamery during the month will be less than what would have been obtained could every particle of butter fat be taken from the milk.

Each patron's milk is tested in the same manner as was A's. B's test called for 100 lbs. of butter, C's for 150 lbs, D's for 140 lbs., and so on for all the patrons.

The total test yield or the amount of butter that should be made according to the different tests will almost invariably be larger by 50 or more pounds than the actual yield, and he is a good creamery man who makes the actual yield equal to the test yield.

A simple proportion used to reduce the different amounts of butter as called for by test yield to the exact test yield is:

Total test yield is to each man's share, or using the figures assumed, we have supposing there was made at the creamery (actual yield) 3,000 pounds of butter. According to the tests, there should be 3,050, and according to A's test he should receive 150 pounds. Then—

Total test yield.		A's test yield.		Actual test yield.		A's actual share.
3050	:	150	::	3000	:	x, A's share.

x=147.5, and by a similar ratio each patron's share is determined.

This testing is the only means of getting at the quality of milk and what is practiced at the creamery may be done at home with the dairy herd.

Each cow should be tested and there will be found in every herd one or two that do not pay for the food consumed.

We cannot afford to keep in our herd such cows, for it is evident that they are kept at a loss, consuming food and not making butter enough to pay for it.

Dairying like all other farming is subject to close competition and the accepted law of the "survival of the fittest" applies to this as well as to all progressive things.

We must not keep cows that will not pay for food and labor, but must free ourselves of them and have none but good milkers, quality rather than quantity being considered.

Could a regular scale be made out, putting in logical order the most important things of a dairy herd, I should say: first in importance is breed. Food and care are so closely connected, being mutually dependent, that it would be hard to say which should be placed first. Good food and poor care or poor food

and good care are about equal; but as it is expected to have both good food and good care, I would say second in the scale food, and third care.

On these three factors, breed, food and care, together with the energy and enterprise of the farmer, depends the success or failure of all who engage in the creamery industry.

PLAN OF ORGANIZATION.

It is a well known fact that no enterprise, however simple, can make even fair progress without some guide or head. Neither can a community expect to do anything in the Creamery business unless some of the enterprising men take the matter in charge; see to perfecting an organization of the farmers; electing a President, Secretary, etc., and appointing committees to probe the whole subject to the core.

No one plan that could be suggested would suit every community; but the following is given, it being the way that we have succeeded in getting several organizations in different parts of the State. Have it generally understood that on a certain day, at a certain place and hour, those interested in the improvement of their interests are to meet to discuss the advisability of engaging in the Creamery business. An energetic man should be made President of the organization, another made Secretary, and a committee should be appointed to ascertain the number of cows that can supply milk to the Creamery. This would complete the business of the first meeting, and another day for meeting should be appointed. Before the time of second meeting, the subject can be discussed privately by all the parties, while the committee appointed gets the necessary data in regard to the number of cows. The Secretary can inform the Station of the action of the organization, and if it is desirable on the part of the farmers and arrangements can be made at the Station, one of the Staff will go to the second meeting and give any assistance that can be rendered. If a company is formed, or if a private party desires to go into the business as an investment, the Station will, as I have said, send a man to any community in the State to adjust the machinery and stay in that community a month or so and instruct one whom the company may choose, in the art of

manufacturing Creamery butter, and in running a Creamery in first-class style. This assistance, it must be understood, is given free of all charge to the company or private party engaging in the business.

WHAT IS THE ADVANTAGE OF A CREAMERY IN A COMMUNITY?

We have given, in this Bulletin, all points that are essential to be known before starting in the Creamery business. Comparisons have been made to bring before the farmer's eyes the condition of agriculture in our own State. List and cost of apparatus for Creamery is given; plan of building suggested and to those who resolve to go into the business, the Station will send a man to adjust all machinery and instruct one whom the people may choose in the art of manufacturing Creamery butter. This we do free of all cost to the company or private party building the Creamery.

Why do we put this whole matter before the farmers of our State? And why do we offer the services of the Station's Staff free of all charge? Because we believe it to be one of the most important factors, should it be carried out, in solving the problem of redemption of worn out soils and the utilization of our hillsides.

The assertion is made without fear of successful contradiction that in no enterprise can the farmers engage that will return to them, in a shorter time, the capital invested than will the Creamery business. The mode of operation of a Creamery explains how this is. Suppose $500 is invested in dairy cows. This will purchase at least eight that will bear the record already given. Eight cows which will in one month produce, according to the foregoing figures, butter to the amount of $38.24 cts. and this is at the rate of 78 per ct. interest on investment. In what other business can our farmers engage that will pay such a per ct. on investment and declare a dividend each month?

It has been stated by one of the leading men in Ontario, Canada, that the dairy industry has advanced the farming interests of that section far more than the people thought. Several countries have been made productive and wealthy by increasing the fertility of exhausted soils. Farmers who had

bought poor lands had, by this system of utilizing the farm, increased them in value 100 per cent. By thus making these lands valuable $9,000,000 had been added to that country within one year and not one bushel less of wheat or other grains had been grown. Thus a direct gain. The industry had developed a market for the coarser products of the farm and a crop of oat straw was much enhanced in value. It also made provision for human food, which would otherwise be wasted. The farmer's occupation is to produce everything for all his wants. In the dairy business, all these foods were utilized or made fit for human food. A man could live on straw or hay, so to speak, for these were converted into nutriment fit for use in the human body, and five times the population could be supported by dairying than by any other system of farming. In proof of this, it was found that dairy districts were more thickly populated than where a mixed husbandry was practiced; thus, property in those sections increased in value and a permanent prosperity was established. Three-fourths of the food consumed came from dairy farming; beef, pork and poultry are mainly the outcome of dairy farming. All in all, dairy farming has done more for the country than all the emigration agents and speeches for many years.

We would not have you believe that there is little labor connected with this style of farming; but on the other hand, wuold forewarn those who have any idea of engaging in this enterprise, that with it is connected labor, and that of an intelligent character; but we do believe it to be the road to success where we are dependent upon the farm for our support.

BULLETIN NO. 5.

OF THE

WEST VIRGINIA

AGRICULTURAL EXPERIMENT STATION,

AT

MORGANTOWN, W. VA.

JUNE, 1889.

"THE SELECTION OF MILCH COWS."

BY A. C. MAGRUDER.

JOHN A. MYERS, Director.

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THE SELECTION OF MILCH COWS.

On the selection of milch cows depends largely the success or failure of those engaged in dairy farming. Before buying a cow, we must know exactly for what purpose she is to be used. To produce milk for butter, to produce milk for cheese, or to produce milk for sale as milk. The above are three distinct classes, and fortunately there are cows in this State to fit each class.

If the object is to supply milk to creameries, it is to the owner's advantage to procure cows that will yield milk rich in fat. "Quality rather than quantity" being considered, If the object be to supply milk to a cheese factory, milk rich in casein or cheesy matter should be sought, and quantity as well as quality should be considered. If the object be the delivery of milk to private consumers, it is desirable to keep well up to the standard of good milk, which by analysis is found to be :

Water	87.5	per cent.
Fat	3.4	per cent.
Ash	.7	per cent.
Casein	3.9	per cent.
Sugar	4.5	per cent.
Total	100.	per cent.

The object of this bulletin, however, is to deal principally with the selection of cows for supplying milk to creameries, where butter is the main product of manufacture.

No one will deny the statement that it costs no more to keep a good cow than to keep a poorer one. We would strive to impress upon the minds of the farmers the superior value of good, over bad cows, and to that end is given points to guide in the selection of the best.

There are no set rules to be followed in the selection of a butter cow, but a combination of good points is to be looked for that shows the capacity of the animal for producing milk rich in fat. In working with the native cattle of our country, there exists two serious difficulties.

1st. The average low capacity for yield in butter.

2nd. The uncertainty of results in selecting stock that has never been tried.

The fact that "like produces like" is well known. In standard breeds of dairy stock, where both sire and dam are from a strain of fine milkers, we seldom fail to procure a good cow, but with the native cattle no reliance can be placed on either sire or dam, as the bad qualities of ancestors may appear in the offspring at any time. The above difficulties, though radical, can be overcome in part by a few years of careful selection and breeding. It will take much time to rear a good dairy herd, and even then, there is not the absolute certainty of producing good milkers as there is in the old and well established breeds. To purchase a thoroughbred herd of cattle is out of the reach of many of our farmers. In the absence of the thoroughbred, however, the next best method to be pursued is to procure a thoroughbred male of the breed decided upon as best for the purpose intended, and by a system of proper selection, and grading from the native cow, a fair line of milk and butter cows can be produced. We are dependent upon the native stock of the country, and by proper and judicious handling of these we believe more profit can be realized than from the sale of the usual standard crops, sheep, or beef cattle.

In the selection of milch cows, as has been said, no definite criteria can be given, but good cows possess certain points that seldom lead one astray, and the greater number of points that can be found combined will indicate with more certainty the capacity of the animal at the pail.

Points Usually Possessed by Good Milch Cows.

First, and of prime importance is that she should be descended from a line of good milkers. Head, small; muzzle, fine; nostrils, flexible and expanded; face, long, slender and dishing; mouth, large; lips, thick and mild in expression; horns, of any shape, delicate and waxy; ears, long and thin with a few soft, silky hairs on inside where skin is of a decided yellowish color; neck, thin and small where it joins head; chest, deep, indicating well formed respiratory organs; back, broad and level; belly, large and well ribbed; low flank; thigh, wide but thin; legs, short, standing well apart; large milk veins; udder, loose, large, soft, pliable, square in form, or nearly so, projecting well out behind the legs; four good teats not too large, set wide apart and pointing slightly outward; skin, loose and mellow, and of yellowish color; hair, fine, thick and glossy; disposition, quiet; milk-mirror or escutcheon (explained further on) well marked, being free from patches or tufts of down-growing hair.

No two men of a section rarely ever decide upon the best breed of stock for the dariy, unless the two are accustomed to handling the same. We are apt to consider best that which we have the longest used and to what we are most accustomed. To name the breed that would be most remunerative to farmers of the differ-

ent sections of this State would be impossible, because too many points of difference exist in the different parts of the State. The pasture that would keep well one breed might not half keep another. Small cows can travel over much more steep and rough ground than can larger ones, and if pasture is scant, the smaller cow would stand the better chance of obtaining more food.

Large cattle are bred where there is an abundance of good food, and they require it wherever they are kept or they will decline. Smaller cattle, accustomed to more moderate fare, do well on moderate pasture. "Stock should be transplanted from good to poor land no more than should trees."

Explanation of Escutcheon or Milk-Mirror.

In the selection of milch cows, no part of the body offers surer signs of the animal's capacity at the pail than does the escutcheon or milk-mirror, and adjoining parts.

Guenon, a Frenchman, was the first to notice the connection of the milk producing organs with "certain external marks on the udder and parts above it, or prenium, extending in some cases, as far up as the vulva, as low down as the hocks and spreading to a greater or less extent out on the buttock." These external marks were given the name of escutcheon or milk-mirror. They are known by the hair upon them growing in an upward direction, while that of the rest of the body grows downward.

There are many different forms of escutcheon, and each has its special significance. Guenon first classified them in such a way, giving the value of each form and size, that he could, by simply looking at the escutcheon, tell the capacity of the animal, the quality of the product, and the length of time she would remain in milk. His classification, however, which consists of more than seventy classes, sub-class, etc., is entirely too complicated to be used to advantage and it has been discarded by many of the most learned as too tedious and complicated for general use.

While the escutcheon is almost a correct guide, there are exceptions where cows with scarcely perceptible escutcheons are fairly good milkers, and also cows with well developed escutcheons, covering a great amount of surface, are poor milkers.

The milk vessels are found beneath the upturned hair about the udder; hence, the greater number of milk veins, the greater the extent of upturned hair, and *vice versa;* the larger the escutcheon the greater the number of milk veins; hence the greater the yield of milk. In other words, as the veins are beneath the escutcheon, we judge their number by the extent of the escutcheon. The escutcheon is usually determined by a perceptible ridge formed by the meeting of the hair growing in different directions. When not

Fig. 33.

Fig. 34.

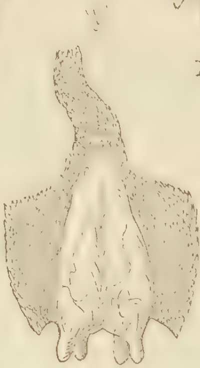


Fig. 36.

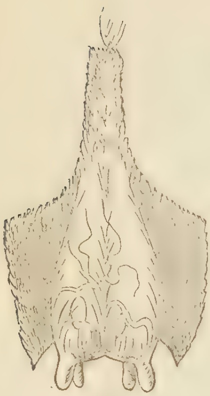


Fig. 35.

Fig. 37.

easily determined thus, the animal may be made to walk a few steps forward when the escutcheon may be outlined by different reflections of light upon the parts. If this fails, the finger's end may be run over the parts, and when the nails come in contact with the hair growing in the opposite direction from the way the hand is

being drawn, it will determine the position of the escutcheon by raising the hair growing in the opposite direction from the moving hand.

Fat covers many faults, and care is to be exercised in examining escutcheon as to the condition of fat of the perineum ; and also the fullness of the udder ; as a fat cow, or a distended udder shows a larger escutcheon than there really is.

By Flint, there is a division of the escutcheon into upper and lower tufts. The upper tufts are small in comparison with the lower. and are set in close proximity to the vulva, as seen at "S," Figs 38, 39 and 40. These tufts appear on cows belonging to poor milk stock, but are seldom seen on good milch cows. The tufts consist of small parts of upturned hair, and show the continuation of flow of milk. The larger these tufts are, the shorter the milking period. These tufts are not escutcheon, and are easily distinguished by the bands of hair, as shown in Figs. 38 and 40. The lower tufts are divided into two parts. 1st. Mammary, or the part covering the milk glands, thigh and legs. 2nd. The perinean, or the part extending over the perenium proper. The classification of Magne seems the most simple and accurate. As we have it from Flint, he divides all cows into four classes follows:

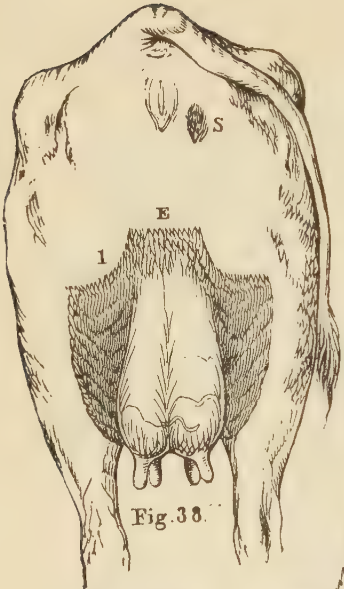


Fig. 38.

Fig. 39.

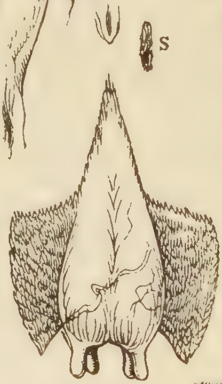


Fig. 41.

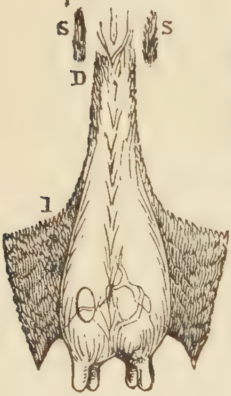


Fig. 40.

Fig. 42.

1st, very good ; 2nd, good ; 3rd, medium ; 4th, bad.

In the first-class is placed cows both parts of whose milk mirror, the mammary and perinean, are large, continuous and uniform, covering at least a great part of the perineum, the udder,the inner surface of the thighs, and extending more or less out upon the legs, as in Fig. 33, with no interruption, or if any, small ones which are oval in form, and situated on the posterior face of the udder, Figs. 33 and 35.

Such mirrors are found on most very good cows, but may also be found on cows which can scarcely be called good, and which should be ranked in the next class. But cows, whether having very well developed mirrors or not, may be reckoned as very good, and as giving as much milk as is to be expected from their size, feed, and the hygienic circumstances in which they are kept, if they present the following characteristics :

Veins of the perineum, large and if swollen, and visible on the exterior, as in Figs. 35, 38, or which can be easily made to appear by pressing upon the base of the perineum ; veins of the udder, large and knotted, milk-veins large, often double, equal on both sides, and forming zig-zag under the belly.

To the signs furnished by the veins and by the mirror may be added also the following marks :

A uniform, very large and yielding udder, shrinking much in

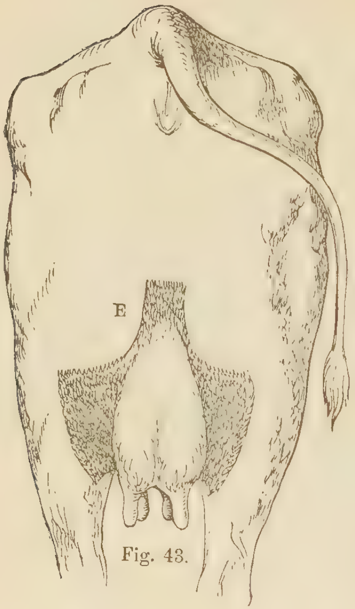


Fig. 43.

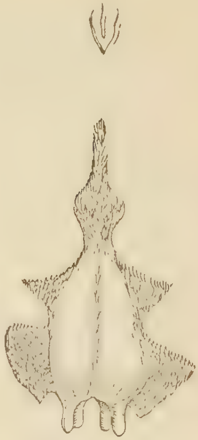


Fig. 44.

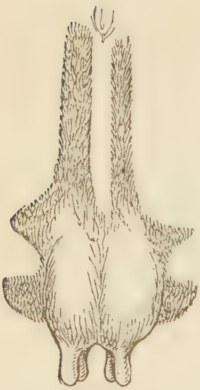


Fig. 45.

Fig. 46.

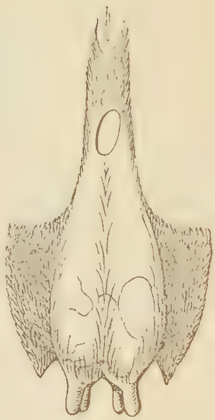


Fig. 47.

milking, and covered with soft skin and fine hair; good constitution, full chest, regular appetite and great propensity to drink. Cows rather inclining to be poor than fat. Soft, yielding skin, short, fine hair, small head, fine horns, bright sparkling eye, mild expression, feminine look, with a fine neck.

Cows of the first class are very rare. They give, even when small in size, from ten to fourteen quarts of milk a day, and the largest sized from eighteen to twenty-six quarts a day, and even more. Just after calving, if arrived at maturity and fed with good, wholesome, moist food in sufficient quantity and quality, adapted to promote the secretion of milk, they can give about a pint of milk for every ten ounces of hay, or its equivalent, which they eat.

They continue in milk for a long period. The best never go dry, and may be milked even up to the time of calving, giving from eight to twelve quarts of milk a day. But even the best cows often fall short of the quantity of milk they are able to give, from being fed on food that is too dry, or not sufficiently varied, or not rich enough in nutritive qualities, or deficient in quantity.

The second class is that of good cows, and to this belong the best commonly found in the market and among the cow-feeders of cities.

They have the mammary part of the milk-mirror well developed, but the perineum part contracted or wholly wanting, as in Figs. 34 and 37; or both parts of the mirror moderately developed, or slightly indented, as Figs. 35 and 36. Figs. 38, 39, 40 and 41 belong also to this class in the lower part; but they denote cows which, as upper mirrors, S S S, indicate, dry up sooner when again in calf.

These marks, though often seen on many good cows should be considered as certain only when the veins of the perineum, form

Fig.48.

Fig.49.

Fig.50.

Fig.51.

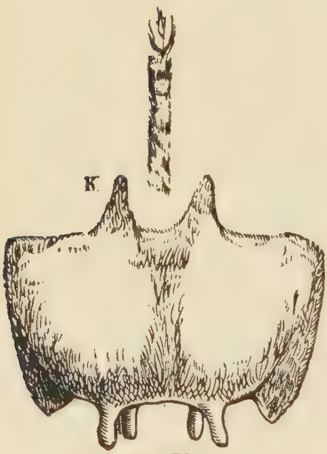


Fig.52.

Fig.53.

nder the skin a kind of network, which, without being very ap- parent, may be felt by a pressure on them; when the milk veins on the belly are well developed though less knotted and less prominent than in cows of the first class; in fine, when the udder is well developed, and presents veins which are sufficiently numerous, though not very large.

It is necessary, then, as in the preceding class, tohave a mistrust of cows in which the mirror is not accompanied by large veins. This remark applies especially to cows which have had several calves, and are in full milk. They are medium or bad, let the milk mirror be what it may, if the veins of the belly are not large, and those of the udder, apparent.

Small cows of this class give from seven to ten or eleven quarts of milk a day, and the largest from thirteen to seventeen quarts. They can be made to give three-fourths of a pint of milk, just after calving for every ten ounces of hay consumed, if well cared for and fed in a manner favorable to the secretion of milk. They hold out long in milk when they have no upper mirrors or tufts. At seven or eight months in calf, they may give from five to eight quarts a day.

The third class consists of middling cows. When the milk mirror really presents only the lower or mammary part slightly developed or indented, and the perinean part contracted, narrow and irregular, as in Figs. 42 to 47, the cows are middling. The udder is slightly developed or hard, and shrinks very little after milking.

The veins of the perineum are not apparent, and those which run along the lower sides of the abdomen are small, straight and sometimes unequal. In this case, the mirror is not symmetrical, and the cow gives more milk on the side where the vein is largest.

These cows often have large heads, and a thick and hard skin. Being ordinarily in good condition, and even fat, they are beautiful to look at, and seem to be well formed.

Cows of this class give, according to size, from three or four to ten quarts of milk. They very rarely give, even in the most favorable circumstances, half a pint for every ten ounces of hay which they consume. The milk diminishes rapidly and dries up wholly the fourth or fifth month in calf.

The fourth-class is composed of bad cows. As they are ordinarily in good condition, these cows are often the most beautiful of the herd and in the markets. They have fleshy thighs, thick and hard skin, a large and coarse neck and head, and horns large at the base.

The udder is hard, small and fleshy, with a skin covered with long, rough hair. No veins are to be seen either on the perineum or the udder, while those of the belly are very slightly developed, and the mirrors are ordinarily small, as in Figs. 48, 49 and 50.

With these characteristics, cows give only a few quarts of milk a day, and dry up a short time after calving. Some such can scarcely

nourish their calves, even when they are well cared for and well fed.

The escutcheon will be found developed partly on all cattle, and it is found extremely valuable in judging young heifers intended for the dairy, or males to be used in grading the herd.

In bulls the escutcheons are always smaller, but are classified as they are in cows.

The escutcheon will be found formed on calves at birth, and in judging calves or heifers, the foregoing remarks will apply to them. It is needless to say that the size of the animal must in all cases be an important point to consider.

Methods Used in Determining Age of Cattle.

One of the most necessary attainments of a good judge of live stock is to be able to determine the age of animals. With dairy cows, the age is quite an important point to be considered, for one does not care to purchase a cow whose capacity for secreting milk is decreasing. The cow is considered to have reached the prime of life at about ten years of age, and from that time there is usually a falling off in the milk supply. This rule, however, is not universal; for cows well kept have been known to give their usual quantity of milk in the fifteenth year.

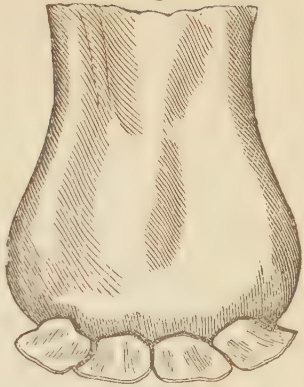
Quite a customary way of determining the age of cattle is by means of rings which are formed annually on the horns. These rings are not correct guides at all ages, but may indicate approximately the age between the third and tenth years. The horn is perfectly smooth until the third year, when a ring is formed at its base. A ring thereafter occurs annually, and by adding two years to the number of rings upon the horn, the age may be determined. The above is the case when the formation of rings has been uniform, but so liable are these formations to abnormal growths that no accurate dependence can be placed upon the system.

The teeth, however, afford the most accurate means within our possesession of determining the age where no record has been preserved. The calf at birth, or soon after, has two front teeth, termed nippers, first middle teeth, or incisors, as shown in plate 1. In two weeks after birth, a tooth has appeared on each side of the middle teeth already formed. These are termed second middle

1

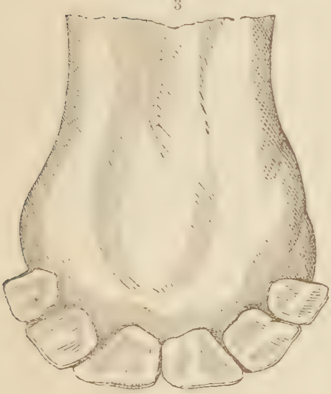
ONE WEEK.

2



TWO WEEKS.

3

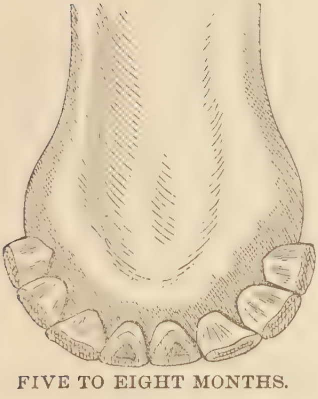


THREE WEEKS.

4

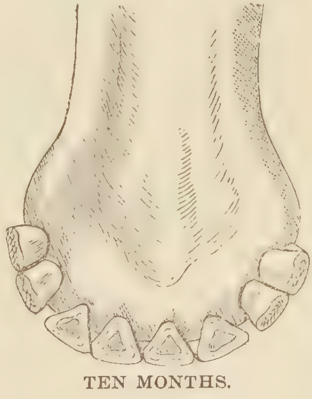
FOUR WEEKS.

5



FIVE TO EIGHT MONTHS.

6

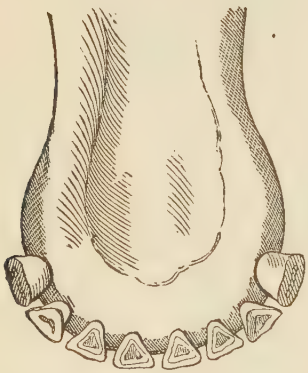


TEN MONTHS.

teeth (plate 2) and during the third week, there appears a tooth on each side of the last teeth formed (plate 3) and by the fourth week, usually, the mouth is full, as shown in plate four. These teeth of the first month are not permanent, but are very soft, and are gradually worn off and absorbed to give place to the formation of a new and permanent set.

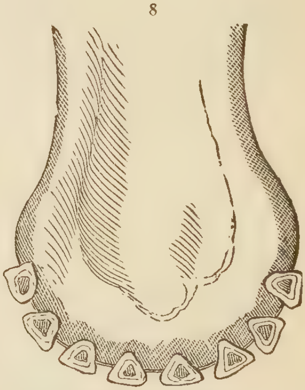
After the calf has attained age sufficient to admit of partaking solid food, the teeth begin to wear off very rapidly, and the amount of wearing indicates the length of time thev have been used. It will be found that the center pair of the first teeth that appeared are the first to begin to wear, the wearing beginning on the inner line of the teeth. In many cases, the wearing has begun before the appearance of the last pair of temporary teeth. From six to eight weeks old, the teeth still remain sharp upon the outer edge. The wearing extends gradually outward from the center pair, and at about the age of four months, the entire set is worn so that it presents a decidedly flat appearance. The center being flattened more than the outer. After the age of four months, a shrinkage or absorption of the teeth sets in and they are diminished in size, thus becoming separated, as well as becoming more and more flattened. From five to eight months of age, the teeth appear as in Plate 5, while in plate 6, may be seen the representation of the teeth at ten months. At twelve months or a year, the teeth are much smaller, are still contracting, and are worn down, as shown in plate 7. At the age of fifteen months (plate 8) the outer teeth are worn to one-half their size, while the inner are still smaller.

7



ONE YEAR.

8

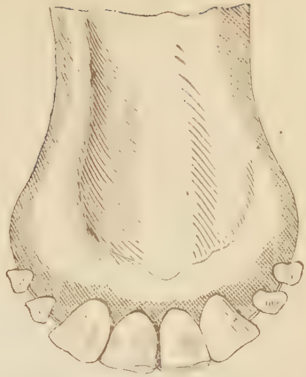


FIFTEEN MONTHS.

9

EIGHTEEN MONTHS

10



TWENTY-FOUR MONTHS.

11

THREE YEARS.

12

FOUR YEARS.

13

FIVE TO SEVEN YEARS

14

TEN YEARS.

During the time occupied in the shrinking of the first set of teeth, the permanent ones have been slowly growing, and as the first pair that appeared in the mouth are absorbed or pushed out, a second, but permanent pair, appears in the place of the first, and are known as the first pair of permanent incisors. A representation of the mouth at this period is shown in plate 9. "This plate also represents the internal structure of the lower jaw-bone, and the process of the formation of teeth. Fig. 1. on the plate represents the first pair of permanent teeth appearing in the mouth. Fig. 2, the second pair about to push through the gum. Fig. 3, the third pair just forming." At twenty months, two pairs of teeth are in the mouth, while at two years the mouth appears as shown in plate 10. The growing of the third and fourth pair of teeth require one year each, while the same time is required for the third and fourth pair of temporary or milk teeth to become absorbed or pushed out. At three years the teeth are represented in plate 11, while at four years all of the teeth have made their appearance, and the mouth is full. At three years of age it will be noticed by the plate that the teeth have begun to wear off. At four years the wearing has extended to the second pair of teeth, while in the fifth year the three middle pair of teeth are worn down so that a dark line appears at the center of the first middle pair along the line of harder bone structure. The fourth or last pair of teeth at this age are worn slightly. From five until seven years no decided changes occur, and we are only to be guided by the extent to which the dark line has advanced in the outer teeth. The line may be very decided, and easily seen, or it may be so dim that it requires care to detect it. At seven years the line will usually be found to have extended across the entire set, but this depends upon the character of food, care, etc., to which the animals have been accustomed.

The shrinking or absorption that took place with the temporary teeth takes place also with the permanent set, but much more slowly, and at eight years, the first or middle pair of permanent teeth have contracted so that they are decidedly smaller than the others. In the tenth year, this contraction is extended to the third pair of teeth, and the dark line becomes less visible. At twelve, the whole set is smaller than formerly, while the dark lines are very indistinct in all but the last or corner teeth. Beyond this point, there is no certainty, but the wearing continues until the teeth are worn down to the gums.

NOTE.—The cuts used in illustrating this Bulletin and also parts of explanation thereof are taken from Chas. L. Flint's work on "Milch cows and Dairy Farming," published by Messrs. Lee & Shepherd, of Boston, Mass., to whom I am indebted for the loan of the plates.

BULLETIN No. 6

OF THE

WEST VIRGINIA

AGRICULTURAL EXPERIMENT STATION

AT

MORGANTOWN, W. VA.

SIX MONTHS EXPERIENCE IN RUNNING A CREAMERY. IMPROVED PROCESS OF HANDLING CREAM AND CHURNING.

JOHN A. MYERS, *Director*.

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1889.

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MILK.

Milk must be relied upon by the dairy farmer as his chief source of profit, to be sold either as fresh milk, as cream, as butter or cheese. The great mass of farmers are so located that it will not be profitable for them to attempt to sell the milk or cream as such, and in order to make the products of the cow marketable, they must be converted into either butter or cheese.

The milk supply of creameries varies in composition through a relatively wide percentage; dependent partly upon causes clearly understood, such as breeds of stock, age of animals, period of lactation, character of food, etc., and partly upon conditions with which we are yet unfamiliar, such as nervous condition of the animals, constitutional peculiarties, conditions of health, etc.

The average composition of unadulterated milk is given as:

				VARIATIONS.			
		Average.		Minimum.		Maximum.	
	Water,	87.5	per ct.	85.	per ct.	90.	per ct.
	Dry substance,	12.5	"	10.	"	15.	"
Total Protein Matter.	Casein,	3.2	"	2.	"	4.5	"
	Albumen,	0.6	"	0.2	"	0.8	"
	Lactoprotein,*	0.1	"	0.08	"	0.35	"
	Milk sugar,	4.5	"	3.	"	6.	"
	Butter fat,	3.4	"	2.	"	6.	"
	Specific gravity	1.031	"	1.029	"	1.033	"
	Ash,	0.7	"	0.6	"	0.9	"

The milk delivered at our station creamery gave the following tests for butter fat for the first six month:

May,	3.95 per cent. fat.
June,	4.21 per cent. fat.
July,	4.06 per cent. fat.
August,	4.18 per cent. fat.
September,	4.26 per cent. fat.
October,	4.28 per cent. fat.

BUTTER.

For the present we discuss only the production of butter, and by butter we mean the mechanical mixture of fats produced by causing the fat of milk to coalesce into masses of sufficient size to be readily collected and separated from the milk. This is accomplished by submitting the milk at the proper temperature to violent agitation. Approximately butter consists of 80 to 90 per cent. of butter fat, 2 to 7 per cent. of salts, 1–2 to 3 per cent. of curd, 8 to 15 per cent. of water.

*Doubtful.

WATER IN BUTTER.

It is an easy matter for butter to have such a large quantity of water intermixed with it, that it may amount to an adulteration. It is claimed that as much as 60 per cent. of water can be introduced into butter and the whole sold as butter. It is not an uncommon thing for the country butter to come into the markets in the summer time with as much as 30 per cent. of water mixed with it. This mixing of water with butter, or the imperfect extraction of water from butter, has an important bearing upon the subject of determining the butter producing capacity of cows, and also of judging the quality of butter upon the market.

At our Station Creamery after the butter is in the granulated state, it is our habit to allow it to drain until all of the wash water that will do so, drains out. This usually requires about fifteen minutes. It is then placed upon the butter worker, and fine dairy salt added in the proportion of 1¼ ounces to a pound of butter. The butter is then worked rapidly, and from 10 to 20 per cent. of the original weight of the butter is worked off as salt water. Our Creamery butter, when placed upon the market contains from about 8 to 12 per cent of water.

LOSS IN HANDLING BUTTER.

The nature of butter precludes the handling of it without some loss. This occurs in transferring from one vessel to another, in working and printing the butter and in failing to secure all of the butter from the milk or cream churned. The latter has been, up to the present time, one of the principal sources of loss, and few have taken time to estimate the extent of it.

Prof. C. A. Wulff of the Indiana Station has figured this out, and we incorporate, herewith, a quotation from him upon this subject. (See Dairy World Vol. 8, No. 6, Page 233.)

"The fat in milk depends principally upon three particulars, viz :

The time after the dropping of the calf, the food and breed, but in all controlling fat, we must consider how great a result is to be credited to the influence of very small differences.

For instance, we will give the prices of the fat in the milk, quoting 1 lb. butter equal to 30 cts.

LOSS OF BUTTER FAT, PER 100 LBS. MILK.

Per cent. of fat left in the milk.	Lbs. butter.	Cents.
0.05	0.06	1.8
0.10	0.12	3.6
0.15	0.18	5.4
0.20	0.24	7.2
0.24	0.36	10.8
0.25	0.30	9.0
0.30	0.36	10.8
0.35	0.42	12 6
0.40	0.48	14.4
0.45	0.54	16.2
0.50	0.60	18 0
0.55	0.66	19.8
0.60	0.72	21.6
0 65	0.78	23.4
0.70	0.84	25 2
0.75	0.90	27.0
0.80	0.96	28.8
0.85	1.02	30 6
0.90	1.08	32.4
0.95	1.14	34.02
1.00	1.20	36.0

Before using these figures, we must remember that in the skim-milk is always left some fat, differing in amount, according to differing methods of skimming. By use of separators not more than 0.16 per cent. of fat is left in the skim-milk. The butter-milk contains about 0.06 per cent. of fat, making 0.22 per cent. of fat in the milk that is not to become butter.* If, therefore, of your cows yielding an average 6,000 lbs. of milk a year there is one that gives, for instance, 2 57 per cent. and another giving 3.82 per cent. of fat on the average, the former pays for her food and care as follows: 2.57–0.22 equals 2.35 per cent. fat gives 2.82 lbs. (2 35 lbs.?) butter per 100 lbs. milk, and per year 169.2 lbs. (141. lbs.?) butter equals $50.76 ($42.30). The latter gives milk with 3 82–0 22 equal 3.60 per cent. of fat becoming butter or 4.32 lbs. (3.69?) lbs. butter out of 100 lbs. milk and per year 259.2 lbs. butter (216 lbs?) equal to $77.76 ($64.80?)."

* Mr. Wulff has made a mistake in his calculations, unless they be based upon other figures than those given in the article quoted. It is possible that he has passed from the percentage of butter-fat to product of marketable butter. As I understand it, 2.35 per cent. of fat is theoretically equal to 2.35 lbs. of butter per 100 lbs of milk, instead of 2.82 lbs. of butter as given by him. The second cow would, according to this, make 3.60 lbs of butter instead of 4.32 lbs, as stated by him. I, therefore, quote his language, but substitute the figures which agree with the chemical analysis of the milk.

The difference between the revenue of these two cows, a year is $22.50. The average difference in fat of their milk equals 1.25 per cent. For a herd of ten cows, it makes $225 a year, and for 100 cows the yearly loss is $2,250, if the average yield of fat in the herd is 2.57, when it could be 3.82 per cent—a sufficient reason, we think, for the proprietor and breeder to know not only his herd, but also each individual, as to its fat producing ability.

It will be seen by the above that he calculates that a separator may lose as much as 0.16 per cent. of the fat in the skim-milk, and that buttermilk will contain about six-hundredths per cent. of fat, making a total loss of 0.22 per cent of fat due to inability to properly extract it from the milk.

The average loss of butter fat in skim-milk at this station during the months of July and August was 0.19 each, and in the buttermilk for July it was 0.57 per cent., and for August 0.47 per cent. We were churning ripened cream. It should be remembered that this, however, is not 0.76 and 0.66 respectively of the whole milk. The 0.19 per cent. is of the whole milk, while the 0.57 and the 0.47 per cent. are percentages of the cream separated, or percentages of 1.5 of the whole milk. For example, supposing we are handling 1000 lbs. of milk. There would be about 800 lbs. of skim-milk containing 0.19 per cent. of fat equal to 1.52 lbs. of butter, while the 200 lbs. approximately, of buttermilk. would contain in July 0.57 per cent. of fat, or 1.14 pounds of butter, and for August 0.47 per cent. of fat, or 0.94 lbs. of butter. This makes a total loss of butter fat per 1000 lbs. of milk for July of 2.66 lbs., and for August 2.46 lbs., equivalent to 0.26 per cent. and 0.24 per cent. of the whole milk. This may appear unnecessarily large at first thought, but when we remember that this number is multiplied by five, or more where the milk is handled as it ordinarily is at the farm houses, we may consider it a material advance. It is confessedly much too large, but was about as well as could be done until some improvement in handling or churning milk was made.

In order to save this wastage, and also to secure butter of better keeping qualities, we endeavored to churn sweet cream. We also have a demand for sweet cream butter, which necessitates our churning it regularly. This, however, entailed a loss of about ten per cent., and frequently as high as fifteen per cent. of the cream which passed off in the buttermilk unchurned, unless the churning was carried so far as to damage the quality of the butter. The churning of sweet cream in the past has always met with this objection.

NEW PROCESS OF HANDLING CREAM.

The cream, as it comes from the separator, is a mixture of irregular composition, and in churning some portions of it usually unite and granulate before other portions of it are ready to pass into butter, so that the result has been that either too small a

yield has been secured, or the quality of the butter has been spoiled to increase the yield. A number of efforts were made by us to overcome the difficulty by attempting to regulate the temperature, revolutions of the churn, by drawing off the milk after the granulation first took place, and churning the remainder separately, etc., until at last our creamery-man struck upon the idea of running the sweet buttermilk through the separator. This takes out all the unchurned cream and leaves a skimmed buttermilk containing less than 1-10, generally scarcely a trace of butter fat in the skimmed buttermilk.

Our separator is now run by our creamery-man, Mr. A. C. Magruder, so that it is the rarest thing that an appreciable amount of fat is left in the skim milk. In fact, by our process here we now usually fail to detect more than a trace of fat present in the skim-milk.

METHODS OF ANALYSIS.

We have used as methods of testing Short's method, the lactobutyrometer and lactocrite. Some may be skeptical as to the results secured by the first two. We believe, however, that all will admit that the lactocrite works as closely as the most careful chemist can work by the gravometric method.

VARIATION OF TESTS.

During the month of July, we carried through our tests of milk by the lactocrite, Short's method and by the lactobutyrometer.

The averages for the month were as follows:

Lactocrite 4.08 per cent.
Short's method 4.05 per cent.
Lactobutyrometer 4.06 per cent.

This is the average of about 150 analyses of the same samples of milk.

During the month of August these stood as follows:

Lactocrite 4.25 per cent.
Short's method 3.98 per cent.
Lactobutyrometer 4.32 per cent.

This month Short's method is out of line owing to the quality of tubes supplied by Cornish, Curtis & Greene. It is only a delusion to apply any test with imperfect or improperly graduated apparatus.

As before stated, by running the separator with more care, it was found that we could skim the milk to within 1-10 of 1 per cent. as is shown by the following record:

Oct.	30,	Skim-milk	blank.
Nov.	5,	"	"
"	8,	"	"
"	9,	"	"
"	16,	"	"
"	18,	"	"
"	19,	"	"
"	20,	"	"
"	21,	"	"
"	22,	"	"

The sweet cream buttermilk before separation contained :

		Per cent. of fat.
October	30,	1.543
"	31,	7.514
November	4,	1.441
"	9,	1.543
"	14,	2.563
"	19,	1.747
"	20,	2.461
"	21,	1.543
"	22,	1.951

After separation, it contained less than 0.1 per cent. or is blank as follows :

		Per cent of fat.
October	30,	Blank
"	31	"
November,	4,	"
"	9,	"
"	14,	"
"	19,	"
"	20,	"
"	21,	"
"	22,	"

The above constitutes a series of tests made after our arrangements for controlling the temperature and flow of milk into the separator had been perfected.

NEW METHOD OF CHURNING SWEET CREAM.

By this process, it will be seen that the milk is skimmed by the separator until the butter fat is extracted almost to within the limits of chemical analysis. The quality of the butter is maintained and it is all handled in the granulated condition just as if it had been churned in the usual way.

The milk at the Creamery is delivered sweet every morning,

and embraces the evening and morning milkings. When the weather is sufficiently warm to cause the milk to sour, the milkings are brought to the Creamery in separate vessels. The milk as delivered by the farmers is immediately run through the separator, and about one-fifth thrown out as cream. The other four-fifths is taken home by the farmers as skim-milk. As soon as we are done separating, the cream is cooled to from fifty to fifty five degrees to remove the animal heat and reduce it to the proper temperature for churning. It is then put into a Blanchard revolving churn and churned at from thirty eight to forty revolutions to the minute until the butter granulates in the usual manner; when the churn is stopped, the butter milk drawn off and again run through the separator, as mentioned before.

EXACTNESS OF THE WORK.

We do not claim that we scecure as butter every particle of fat in the milk. Our tests, however, indicate to us that we are working by this process to within the limits of error in chemical analyses and closer than it is possible for us to work by the ordinary system of churning. It remains to be tried in other Creameries and tested in other laboratories as to whether the process is worthy of general acceptation. With us it has worked well.

DIFFICULTIES IN BUILDING UP A SELECT TRADE.

Great difficulty was experienced in finding a market for our product at the time of starting. On starting, shipment after shipment of butter to commission merchants in the East and to other large cities was sold to them at reduced rates, and our butter condemned by them as may be seen by the following letters. We were then churning ripened cream.

PHILADELPHIA, MAY, 18, 1889.

DEAR SIR:

I shall be glad to handle the product of your creamery, but can only do it to your advantage and satisfaction and mine when you make a uniformly good article and send regularly. You may not know that it takes a little time to get a good trade on butter, or rather on a particular mark of butter. At this present time, which condition will continue, no doubt, until perhaps July, the state of the butter market is quite unsatisfactory both as to price, which is low, and to movement which is slow, and one can not get the top price for an article, however good, that is received only occasionally.

My commission on solid packed butter is 5 per cent. On pound or half pound prints it is 2 cts. per pound.

I shall be pleased to hear from you by letter and shipment and will do the best I can for you.

Respectfully yours,

"O. W. W."

PHILADELPHIA, June 13th, 1889.

DEAR SIR:

Your butter is sweet, but appears to lack flavor and does not give our customers satisfaction. Of course, our customers will be judges of what will suit them.

Yours truly,

"J."

PHILADELPHIA, June 4th, 1889.

DEAR SIR:

The tub of butter was received from you on the 23rd of May. We placed it in our refrigerator when it came in and we have had such an overstocked and unsatisfactory market since that we have never taken it out or offered it. Your butter is not strictly fine, and will not compare with our fine makes. Fancy Elgin Creamery is selling at 17 and 18 cents, and average receipts not over 14 and 15. Will send you account of sales and check when sold. We look for a better condition of affairs soon.

Yours respectfully,

"E."

PHILADELPHIA, June 25th, 1889.

DEAR SIR:

We enclose you account of sales of the tub of butter received May 23rd, and check to balance. We regret that we can not return you a more satisfactory account of this sample tub, but our market has been in a very unsatisfactory condition for some weeks, with receipts very heavy and no butters except those showing fancy quality and No. 1 keeping quality have brought full prices. This quality your butter lacks. In fact, we have never had any from West Virginia that would fill requirements.

We shall always be pleased to receive your shipments, and, as a ruleour account sales and remittances are very prompt.

"E."

WHEELING, W. VA., May 23, 1889.

DEAR SIR:

Please find, enclosed, check in payment of butter received from you. We disposed of this lot of butter, but have come to the conclusion, that we can not handle any more of it at present, so please do not send us any more of it unless we order. Country butter is so cheap that creamery butter has very small sale.

Regretting that we cannot use your product, we remain,

Yours truly,

"C. & S."

BALTIMORE, MD., May 22, 1889.

DEAR SIR:

Please find, enclosed, statement of sales. Do not ship us any more butter. We are full just now. "P. & S."

We are fully aware that any one in looking over these letters would receive the impression that we were not making a good quality of butter, and that is evidently the impression that the commission merchants intended to make. These letters are quoted to show the difficulties with which a new creamery may expect to contend.

The creamery business is like any other business, in that those conducting it must establish for it a good name. When a creamery begins business, its managers must expect to be met by this difficulty. The commission merchant has no interest in the creamery further than he can make it a source of profit to himself, either directly or indirectly, and the creamery dealing with him may expect a regular series of complaints similar to those above given. The truth of the matter is—we were shipping those merchants, as pure and excellent butter as can be made from the average milk delivered at a creamery, and we have every reason to believe that it reached them in good condition. It was a new enterprise, however, and we were naturally supposed to be quite sensitive to such criticisms. This, of course, would give ground for selling at less than the price of "fancy creamery." I doubt whether any creamery without an iron-bound contract for a regular delivery of so much butter per week the year around can get the average commission merchant to acknowledge that it is shipping to him a fancy product. It is human nature to buy as cheap and sell as high as possible, and it is wonderful how this phase of it develops when the creamery is located several hundred miles away from the city in which the butter is sold.

The privacy of business transactions prevents us from quoting from letters commending the butter, and for that reason alone we withhold them. They are, however, on file at our office and can be seen by parties interested. Suffice it to say that our butter is now daily upon the tables of the highest officers in the country, and in private cars and used by the families of railroad magnates and some of the most distinguished men of our nation.

DIFFICULTIES TO BE OVERCOME.

We found it impossible at first to enter into contracts with any of the hotels, or railroad eating houses or commission merchants to handle our product. We entered the field with the reputation of the butter of the State as bad as it could be; with a market to develop, and with all of the diffculties connected with handling and shipping butter to overcome. The confidence of the farmers was to be gained; the doubts in the minds of the Board of Regents were to be removed; the imperfections incident to the organization of the enterprise were to be overcome, and with it all insufficient facilities for storing and packing the butter, to hold it for a favorable market. Our local market was crushed by hundreds of pounds

of country butter being delivered in the city which, run the price of country butter down to six cents per pound, and a drug upon the market at that.

At this stage in the enterprise, we made an effort to secure a market for cream in tne ice cream saloons. We tried it in Wheeling and in a number of the railroad towns without success. We made an effort to secure a portion of the cream and milk trade at at Deer Park, but without success. At last an ice cream dealer in this city was induced to try our product, and it was soon found that no better ice cream could be made in the State than he was producing from our cream. This soon gave us an outlet for a portion of our product; and relieved the pressure upon our butter market. The farmers by their own bad management completely crushed the local market so that in a short time the butter market in the town was almost free from country butter, which ceased to come on account of the low price, and our local trade returned to us. A few parties of prominence were induced to try the butter and use it, and it has gradually worked its way until within six months from the time of starting, we find ourselves entirely unable to meet the demand for the product. Its character in the market is established, and we could really sell 1000 pounds per week, if the milk could be secured. Our struggle is now with the farmers to induce them to keep up the supply of milk to hold the trade developed.

DIFFICULTIES WITH THE FARMER'S.

In the past they have had their cows come in in May or June when the maket is glutted with the country product, and when it is almost impossible to find a first class maket for large quantities of butter no matter how excellent it may be, instead of having the cows fresh in October or November when the butter products will be thrown upon the market at the time when butter is scarcest and commands the highest price, and also, when it will be possible for them to keep their cows longer in milk than by the present system.

The task before us has presented itself as follows :

1st. To build up the reputation of and create a market for West Virginia Creamery butter.

2nd. To overcome the difficulties incident to handling and marketing the butter, and get the railroad and express companies to furnish us proper facilities and rates for its transportation.

3rd. To educate the farmers to the idea that there is money in the business, and that it will pay them to engage in it.

4th. To overcome the difficulties incident to all commercial enterprises of this character, with which every business man is familiar.

5th. To demonstrate to the farmers that it is possible to conduct a creamery through the winter in this climate as well as through summer. We are not certain yet whether we shall be able to carry out this demonstration, but our patrons insist

now that they will stand by us and see us through, and endeavor to hold the market through the winter. So far as we are aware, each one patronizing the creamery is entirely satisfied with the result of his experience, and we believe that the darkest days of the industry in West Virginia are passed. When we began work in this State a year and a half ago, there was but one creamery in the State ; now there are six, with prospects of several more starting in the spring.

6th. To advance our knowledge of the chemistry of milk and butter, and to improve upon the methods of handling both.

We believe that substantial progress has been made, and that the improvements proposed will be of no small value to the farmers of this State as well as to the country at large.

Bulletin No. 7

OF THE

WEST VIRGINIA

Agricultural Experiment Station.

—— § ——

I. EXPERIMENTS UPON WHEAT.
II. EXPERIMENTS UPON FRUIT TREES.
III. EXPERIMENTS UPON GARDEN SEEDS, &C.
IV. EXPERIMENTS UPON GRASSES AND FORAGE CROPS.
V. EXPERIMENTS UPON MISCELLANEOUS SUBJECTS.

—— § ——

By JOHN A. MYERS,
Director.

—— § ——

CHARLESTON:
MOSES W. DONNALLY, PUBLIC PRINTER.
1890.

BOARD OF REGENTS OF THE WEST VIRGINIA UNIVERSITY.

District.	Name of Regent.	P. O. Address.
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3.	PEREGRIN HAYES,	Glenville.
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12.	JOHN A. ROBINSON,	Patterson's Depot.
13.	DR. W. W. BROWN,	Kabletown.

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PRESIDENT OF THE UNIVERSITY.

E. M. TURNER, LL. D.,

TREASURER.

JOHN I. HARVEY.

STATION STAFF.

JOHN A. MYERS, PH. D., - - - - - Director.
A. C. MAGRUDER, B. S., - - - - Creamery-man.
H. R. BALDWIN, Jr., - - - - - - Chemist.
DR. CHAS. F. MILLSPAUGH, - Botanist and Microscopist.
SUSIE V. MAYERS, - - Stenographer and Book-keeper.

The work reported in this Bulletin is that carried out by the direction of our Board of Regents under the following resolution, which was passed at the meeting of the Board June 12, 1887.

Order of the Board.

"Ordered, that the Director of the Agricultural Experiment Station, upon the application of the Regent of any Senatorial District in the State, is authorized and directed to expend in making experiments in Agriculture, Horticulture and Veterinary within such Senatorial District the sum of $600; which experiments are to be made under the directions of said Director acting in conjunction with the Regent of the District in which such experiments are made. Full reports thereof shall be made by said Director to be printed and circulated throughout the State. And upon application of any Regent said Director shall furnish to him as many copies of said reports, with all papers and exhibits therewith, as he shall require, properly folded and stamped ready for mailing, or as otherwise required, in order that such Regent may send them post-paid to any address he may desire.

And if such reports shall be furnished to any regent without being stamped, he is authorized and requested to circulate them by mail to citizens of West Virginia, and will be paid such sums as he shall expend for postage, etc., out of the funds of the Station."

In accordance with this order, the following circular letter was sent to each member of the Board of Regents:

MORGANTOWN, W. VA., Sept. 6th, 1888.

Dear Sir:

In carrying out the policy of the Board of Regents in regard to having experiments conducted in each of the Senatorial Districts, it

appears to be desirable to devote a share of our attention to the wheat crop, forming as it does an important source of revenue to the farmers in many parts of the state. It appears to be advisable to try what can be accomplished in the way of trial of new or untried varieties. Should it meet with your approval, therefore, I will cause several varieties of seed wheat to be sent into your District freight prepaid, to such freight stations as you may designate, and to such persons as you may name, not exceeding fifty. The seed will be delivered in $1\frac{1}{4}$ bushel sacks, which is considered the proper amount of seed to sow to the acre. This will make all of the experiments of sufficient size to make it an object for the farmers to undertake the work. They are to have the crop as their reward for making the trial and reporting upon the folllowing points, i. e.: The time and manner of sowing, the character of the soil and its manner of preparation with previous crops grown upon it; the state of the weather at the time and following the planting, the ravages of insects and diseases, the ability of the wheat to resist the winter, and drought, should we have any, the peculiarities of growth and the quantity harvested.

The selection of the experimenters is left wholly to the good judgment of the local regent, and the choice of plats must also be settled by him and the farmer. It is not within the power of the Director to visit all sections of the State in time to assist in any of the work this Fall. It should be properly impressed upon the persons who engage in the work that it is not intended that the seed is given to them free of all obligations.

If they fail to report upon the work, it is simply so much of the funds of the Station diverted from their proper use, as they are intended to give the farmers the benefit of the experience derived from their proper expenditure. It is hoped, therefore, that care will be exercised to see that those who use the seed will give the Station the benefit of their experience, for the good of the public, as the results will be published.

Please inform me what varieties of wheat are now generally used in your district, so that new varieties may be introduced, as little would be gained by sending old varieties. It is now close to seeding time, and I trust that the gentlemen who receive this will give it immediate attention, as otherwise it will be too late. If desired, I will send the wheat directly to the Regent himself, and he may distribute it as he deems for the best.

Respectfully,

JOHN A. MYERS,
Director.

Letter sent to each Farmer to whom Seed was sent.

WEST VIRGINIA EXPERIMENT STATION,
MORGANTOWN, W. VA., ..., 188....

DEAR SIR:

By the direction of ....
the Regent of the University from your Senatorial District, I send you..
....
....
....
....
....
....
.... by ....
to ....where you will probably find it in due time. Should there be any transportation charges upon it when it arrives at that point, please pay the same and send me the freight bill, upon receipt of which I will refund the charges to you, as the circumstances may be such as to prevent pre-payment of the same at the time of shipment.

You will find sufficient in each package for one acre of ground. This is not intended as a present, but you will confer a favor upon the community, and upon the State by making such simple notes and observations for publication as may be called for by the Director of the Experiment Station, together with such matters of interest as you may see fit to add thereto. It is intended for the benefit of farmers throughout the State, and should not be held back.

The Experiment Station is put to a very considerable expense in carrying out this line of experimental work, and its success must depend upon whether the farmers whom it thus attempts to benefit, will meet it half way and freely contribute their experience for the benefit of their fellow-craftsmen.

It is our opinon that if Agriculture is to be elevated and made more profitable it must be brought about by combining the experience of intelligent farmers like yourself, with the careful observations of scientific men in such a manner as to form a more exact foundation upon which to build.

You are therefore invited to help us by contributing such information as may be available, and have been named to me as a suitable person to rely upon.

Yours truly,
JOHN A. MYERS,
Director,

This was also accompanied by the circular giving directions for conducting experiments, as follows:

Direction for Testing the Adaptability of Grains, Grasses, or Fertilizers to the Soils of West Virginia.

Persons to whom seeds of any kind or fertilizers are sent will find them contained in packages of sufficient quantity to be applied to an acre of ground. They are prepared especially with reference to application to an acre of ground.

The farmer will prepare the ground in the usual manner for such crops where seed is to be sown, and plant it in the manner usually adopted in that section of the country. In the case of fertilizers he can apply them either by broad casting them, by drilling them, or by applying them near (*not against*) the plant. In the latter case the farmers frequently make the mistake of placing concentrated fertilizers too close to the plant. The fertilizers sent out should be applied to the surface of the ground, and at most not more than harrowed, or lightly drilled in. They are intended to be *quick acting*, and as the crops to which they are applied generally have the feeding power of their roots distributed near the surface of the soil, it is advisable to allow the fertilizer to be soaked down by the action of the rain, rather than plow it in so deep that the plant will never get the benefit of it.

In making experiments we must have exact quantities for the sake of comparison. By using any of the following dimensions an acre of ground may be readily staked off. All that is required is simply a rope or tape line of any convenient length, say 33 feet or 2 rods long. With this measure off any of the longer lines, say 40 rods. Then from the ends of this line run out the shorter line, say 4 rods, and set in stakes. Observe care to have opposite sides parallel.

10	rods	×	16	rods	=	1	acre.
8	"	×	20	"	=	1	"
5	"	×	32	"	=	1	"
4	"	×	40	"	=	1	"
5	yards	×	968	yds.	=	1	"
10	"	×	484	"	=	1	"
20	"	×	242	"	=	1	"
40	"	×	121	"	=	1	"
80	"	×	60½	"	=	1	"
70	"	×	69½	"	=	1	"
220	feet	×	198	feet	=	1	"
440	"	×	99	"	=	1	"
110	"	×	369	"	=	1	"
60	"	×	726	"	=	1	"
120	"	×	363	"	=	1	"
240	"	×	181½	"	=	1	"

The farmer should make note of and report to the Director the *manner* in which the soil *is prepared* for the crop, the *previous condition* of the soil with reference to the crops grown upon it, the *condition of the soil at the time of planting*, whether in good *physical condition* or not, the *condition* of the *weather succeeding* the *time* of

planting, and *success* in *getting* a *stand*, the *onslaught* of *insects* or *diseases upon the crop*, the *ability* of the *crop* to *withstand* the climate, that is *the percentage* that is able to withstand *drought* or *excessive freezing*, the *peculiarities of the growth of the crop*, *time of ripening*, and the *yield per acre secured*.

These specimens are sent out with the expectation that all the farmers of the State will get the benefit of the experience derived from them, and we must rely upon the intelligence and good judgment of the farmers doing the work for any benefit that the farmers of the State are to derive from them. All the work required in this case is of the simplest possible character. The land should be measured before it is planted, and the yield weighed or measured after it is harvested. As reward for his work, the farmer's report will be published, and the harvest secured will belong to him.

The Station sends out these samples in sufficient bulk to make it an object for the farmer to undertake the work. It is the desire of the authorities of the Station that the farmers mutually support one another. It is hoped that the farmers will freely consult the authorities of the Station and communicate with them concerning all the difficulties as well as the successes that they meet with in their business. Where they have success of any kind it is desirable that others should have the benefit of their experience. Where they meet with failure and disappointment it is desired that we should know it, in order that we may inquire into the causes, and if possible suggest some means of remedying it.

We hope that all will avail themselves of such facilities as the Station may be able to offer, and its Director together with his staff of assistants will at all times stand ready to serve the interests o the farmers.

JOHN A. MYERS,
Director,

I. WHEAT.

The following are the varieties of wheat sent out to be tested:

Michigan Bronze.
Solid Gold.
Velvet Chaff.
Golden Amber.
Nail Club.
Lancaster.
German Amber.
Purple Straw.
Findlay.
Raub's Black Prolific.
Rice.
White Booten.
Fultz.
Hybrid Mediterranean.
Red Russian.
Deitz Longberry.
Reliable.
Tuscan Island.
Valley.
Good.

FIRST DISTRICT.

Variety of wheat tested, "Solid Gold."

Quality of seed, good.

Sowed $1\frac{1}{2}$ bushels per acre, October 27, 1888, on limestone soil, prepared by plowing and harrowing. Condition of soil at time of sowing was very wet; too wet for using a drill. The land in 1887 was in corn. Fair yield. The soil is considered well adapted for wheat. The weather following sowing was very wet, and the stand of wheat secured in the fall was very poor. It was sown so late that the wheat did not get a good start in the fall. Ripened June 20th. Yielded 16 bushels per acre; very nice wheat. Not such a good grain as the "Velvet Chaff," but a very good wheat. Like it quite well, and think it well adapted to this country.

WILLIAM FLAHERTY,
West Liberty, Ohio county, W. Va.

FIRST DISTRICT.

Variety of wheat tested, "Michigan Bronze."

Quality of seed, fine.

Sowed, $1\frac{1}{4}$ bushels per acre, October 27, 1888, on limestone soil, prepared by plowing and harrowing. It was very wet at time of sowing; too wet for the drill. The land in 1887 was in corn; fair yield The soil is considered well adapted to wheat. The weather following sowing was very wet, and stand of wheat secured in the fall was very poor; some of the wheat not coming up until spring. It withstood the winter very well. Ripened July 4th; yield, 20 bushels per acre. The wheat withstands drought and cold, but not wet weather. It grew in shock, while under the same conditions the other did not. Very small grain; do not like it very well.

WILLIAM FLAHERTY,
West Liberty, Ohio county, W. Va.

FIRST DISTRICT.

Variety of wheat sown, "Velvet Chaff."

Quality of seed, excellent.

Sowed $1\frac{1}{2}$ bushels per acre, October 27, 1888, on limestone soil, prepared by plowing and harrowing. Condition of soil at time of sowing was very wet; too wet to use the drill. Land in corn in 1887; fair yield. It is considered well adapted to wheat. Weather following the sowing was remarkably wet and cold. The stand of wheat secured in the fall was not at all good. It is considered by us the best wheat there is to withstand cold. Ripened about June 20th; yield, 16 bushels per acre. This was the earliest wheat I had. The small yield, I think, was due to the late sowing; in consequence of which it got a poor start in the fall, some not com-

ing up until in the spring. I think it the wheat best adapted to this section of the country.

WILLIAM FLAHERTY,
West Liberty, Ohio county, W. Va.

FIRST DISTRICT.

Variety of wheat tested, "Golden Amber."
Quality of seed, good.
Sowed $1\frac{1}{4}$ bushels per acre.
Soil prepared same as other varieties; all conditions the same.
Stand of wheat secured in the fall the same.

Peculiarities of crop: Large, plump, full heads. Straw almost like hazel brush; so stiff you could hardly bind it. Harvested same day as other two; yield was $19\frac{1}{2}$ bushels, measured at machine. It grew very tall. A very hard, plump grain. Number of dozen 37, average bind.

A. R. JACOB,
Clinton, W. Va.

FIRST DISTRICT.

Variety of Wheat, "Michigan Bronze.

Quality of seed very good. Sowed 1 bushel per acre October 10th., 1888, on limestone, clay soil prepared by plowing, harrowing and pulverizing. Good physical condition of soil at time of sowing.

The land in 1887 was in meadow. Yield 2 to $2\frac{1}{2}$ tons of Timothy Hay per acre. In 1886 in Timothy and clover. In 1885 in Timothy and clover. Soil considered well adapted for wheat. The weather following sowing was wet, cold and unfavorable. The stand of wheat secured in the fall was poor, being sown so late. Not so good to withstand frost and drought as "Velvet Chaff." It is thinner on the ground. Rather stiff straw with smaller head. Harvested July 8th. Latest of the three kinds. Yield 18 bushels per acre. Measured at machine. A good hard wheat. Number of dozens 30 average bind. Yielded very well to bulk of straw.

A. R. JACOBS,
Clinton, Ohio County, W. Va.

VELVET CHAFF.

Drilling in wheat. Sowed, the fertilizers received broad-cast, then gave it a stroke with my slant-tooth harrow, slightly covering the fertilizer. I had to sow in corn ground, as I had given up all hope of receiving seed in time to sow last fall; when it came, so late I thought I would take the risk. Of the three different kinds of fertilizer used viz: Royal Bone Phosphate, Orchilla Guano and

Schenk's Fertilizer, my observation was that Schenks' fertilizer gave the best result. We have sown 6 bushels of the different kinds of seeds this fall, and hope to be able to make a more satisfactory report of our test after next harvest.

A. R. JACOBS,
Clinton, W. Va.

FIRST DISTRICT.

Variety of wheat tested, "Velvet Chaff."

Quality of seed, very good

Sowed $1\frac{1}{4}$ bushels per acre, October 15, 1888, on sandy loam soil, prepared by first plowing deep, then thoroughly harrowed and thoroughly compacted with a heavy drag. Condition of soil at time of sowing, very good, excepting a little wet. The same land produced 250 bushels potatoes per acre in 1887; in 1886 and 1885 in pasture; the soil is considered very good for wheat. It was very wet following time of sowing, and scarcely any wheat got through the ground until spring. About one-third of the plat was drowned out by water standing on it. Cannot tell as to the ability of the wheat to withstand frost and drought, as no wheat was frozen or dried out here this season. It is a remarkable wheat to stool out. Wheat was cut with binder July 8th. The yield on $\frac{2}{3}$ acre was 14 bushels. The grain is very plump and hard. Should make excellent flour, but think the straw too soft.

L. C. APPLEGATE,
Wellsburg, Brooke county, W. Va.

FIRST DISTRCT.

Varieties tested: Golden Amber, Michigan Bronze and Velvet Chaff.

Sowed $1\frac{1}{4}$ bushels per acre October 24th., 1888, on rather sandy soil prepared as usual. It rained and kept the ground too wet, so that it did not look well in the fall. The soil at time of sowing was tolerably dry, but very wet afterwards. The soil is considered well adapted to growing wheat. Yield was 10 bushels per acre for Golden Amber. For Michigan Bronze 8 bushels per acre. For Velvet Chaff 7 bushels per acre. The latter did no good. I think the Golden Amber will do here, and the Michigan Bronze is good, but the Velvet Chaff will not do here. I will try the two kinds again,

JESSE HUKILL,
Wellsburg, Brooke County, W. Va

FIRST DISTRICT.

Variety of wheat tested "Velvet Chaff."

Quality of seed good.

Sowed $1\frac{1}{4}$ bushels per acre October 10th, 1888, on limestone clay

soil, prepared by plowing, harrowing and pulverizing as fine as we could; being corn stubble. Soil at time of sowing in good physical condition. Crop grown in 1887 was timothy hay. In 1886 timothy and clover. In 1885 timothy and clover. Yield 2 to 2½ tons per acre.

The adaptation of the soil to wheat is considered good, being a rich limestone clay. The weather following the sowing was wet and cold, and very unfavorable. The stand of wheat secured in the fall was very poor; being sown so late. The wheat lodged in patches, and English sparrows destroyed some heads, being sown near buildings. The ability of the crop to withstand frost and drought very good. It is rather a soft straw with large, well filled head. Harvested July 8th. Very ripe. Yield per acre 24½ bushels measured at machine.

Other observations: You will remember that the seed was caught in the great railroad blockade, so that I did not receive it until the morning of the 10th of October, and sowed in the afternoon. This being so late in the season, I can not consider it a fair test. Considering everything, I think the yield good.

Variety of wheat "Golden Amber."

Quality very fair, with some imperfect grains. Number of dozen 45 average bind. I measured off an acre by your instructions in table.

Sowed 1¼ bushels November 1st, 1888, on sandy land with clay subsoil prepared by plowing, harrowing, dragging harrowing, dragging and harrowing. The soil was in extra fine condition, but very wet at the time of sowing. The same land in 1887 produced 150 bushels potatoes per acre. In 1886, 200 bushels potatoes per acre. In 1885 in pasture. Soil is considered good. The wheat was drilled, and the weather following was cold and wet. The stand of wheat secured in the fall was very poor, owing to the late sowing and wet weather. No accidents or diseases noticed. Ripens from July 5th to 10th. Did not separate from other varieties of wheat in threshing. Early sown on good ground would likely make a favorable impression. The late sowing and wet season, were so much against the crop doing well, that opinions expressed from my past experience would be guesses.

S. C. GIST.
Wellsburg, Brooke county, W. Va.

RECAPITULATION FOR FIRST DISTRICT.

"VELVET CHAFF."

Excellent wheat. Well adapted to the this section.
Considered an excellent wheat.
Not adapted to this section.
Think it well adapted to this section.

GOLDEN AMBER.

Considered good.
Uncertain.
Considered adapted to this section.

"SOLID GOLD."

Not so good as "Velvet Chaff," but a very excellent wheat.

"MICHIGAN BRONZE."

A good hard wheat.
Good.
Grew in shock and under similar conditions other wheat did not.
Not liked.

90 tests were sent to this District, from which 12 reports were received. Of this number the reports were as follows:

"Velvet Chaff."	3	reports were favorable.
	1	reports unfavorable.
"Golden Amber,"	2	were favorable.
	1	report were unfavorable.
"Solid Gold,"	1	report favorable.
	0	reports unfavorable.
"Michigan Bronze,"	3	reports favorable
	1	report unfavorable.

It will be remembered that the blockade in railroad freights prevented, perhaps, one-third of the parties to whom the seed whea was sent from securing it in time for seeding. Other parties, we presume, we shall never hear from.

SECOND DISTRICT.

Variety of wheat tested "Michigan Bronze."
Quality of seed was very good.
Sowed 1¼ bushels per acre November 1st, 1888, on sandy, clay soil, prepared by plowing and harrowing. The soil at time of sowing was wet and the weather cold. The land in 1887 was in oats. Yield was about 20 bushels per acre. In 1886 it was in corn. Soil is considered low. Weather following seeding was cold and wet. Stand of wheat secured in the fall was very poor owing to the condition and time of sowing. It did not start growing until some time in the winter; the ground not settling until freezing. Think this variety will stand frost well. It is a short, thick straw. Short, thick heads, red chaff and beards, and large red grain. Time of ripening July 2d. Yield 12 bushels per acre measured at machine. It is a good wheat for low, wet lands. One small piece of this plat was a black loam and shaded some. I sowed "Fultz" and "Pool" and "Michigan Bronze" side by side in this piece the same day. "Fultz" and "Pool" did not make anything. "Michigan Bronze"

made a good crop. I think it would make wheat to sow in the woods (fresh land).

JESSE L. BONAR,
Glen Easton, Marshall county, W. Va.

SECOND DISTRICT.

Variety of wheat tested "Solid Gold."

Quality of seed was good.

Sowed 2 acres 1¼ bushels per acre, October 11th., 1888, on clay soil, prepared by plowing, harrowing aad dragging to make a fine seed bed. The soil at time of sowing was very wet, and rained all the time of drilling in the wheat. The same land produced in 1887 eight bushels of wheat per acre. In 1885 and 1886, it was in grass. The soil is not considered very good for wheat, and the weather following sowing was very wet. The stand of wheat secured in the fall was very good; being sown late, and in the mud. Noticed no accidents, diseases nor other damage to the crop. This variety stood the weather of June very well, and also stood the frost of winter well. It is a hearty looking plant during winter, with nice, golden bright straw. It ripened 9th. of July. The yield was 18½ bushels per acre from machine. Is a long straw. A good variety for thin land. Would not advise sowing on rich, black soil, or on low lands. Making long straw, it would tangle and not fill. Can not be beat for high thin lands. It is the best variety we have in our section for the high, thin lands. Has a large red grain with long heads and straw.

JESSE L. BONAR,
Glen Easton, Marshall County, W. Va.

SECOND DISTRICT.

Name of variety "Nail Club."

Quality of seed not very good.

Sowed 1¼ bushels per acre October 11th., 1888, on clay soil containing a little soapstone, prepared by plowing, harrowing and dragging to make a fine seed bed. The soil at time of sowing was wet. The weather in this section being wet it was not a good seed time. In 1887 the same land produced about 8 bushels wheat per acre. In 1886 it was in grass. The weather following sowing was very wet, and the stand of wheat secured in the fall, was good considering the wet time of sowing. The wet weather the last of June 1889, damaged the heads, and being compact and holding the water seemed to kill the chaff. Believe the variety will stand frost well. It is a fine plant during winter, growing a very short stiff straw with short close heads, ripening 9th., July. It yielded 17½ bushels per acre from machine. About ½ acre of the plant was very poor and light and the wheat did not do anything. I think I would have had as much wheat if this place had not been sown. I think the wheat is a good variety; being a small, plump grain. By compar-

ing the wheat received last fall with what I grew from this seed, I see it improving, or what I have grown is a better quality. Making it short, the Nail Club "will yield more," everything being the same, than any other wheat I have ever grown.

JESSE L. BONAR,
Glen Easton, Marshall County, W. Va.

FAIRMONT, W. VA., Nov. 19, 1889.

MY DEAR SIR:

The eighteen bags sent me last fall were distributed as follows: In Paw Paw district of this county one bag to J. A Floyd, one to John Straight, one to Z. G. Morgan and two to O. P. Floyd. In Mannington district, one bag to Jacob Myers, one to J. J. Murray, one bag to Fleming Hamilton and one bag to A. Z. Riggs. In Fairmont district, one bag to Charles Conaway, one bag to Thomas Conaway, one bag to B. D. Fleming, one bag to John B. Gray, one bag to M. L. Fleming, one bag to E. Hamilton and one bag to Eugenius Wilson. Lincoln district, one bag to S. E. Fleming, and one bag to T. R. Hall, in Winfield district.

The wheat was delivered to all except Messrs. B. D. and M. L. Fleming, who failed to get the bags left for them from the depot, which fact did not come to my knowledge until in the spring when I had the two bags taken home and this fall had them carefully seeded by a neighbor. I would rather you would turn the price of those two bags into the Station funds, and draw on me for the amount. I have been informed that the wheat sent to Mannington district, was received too late to be seeded and was not, in fact, sown until this fall. This I only have from hearsay, as I have failed to hear personally from any of the parties. I enclose you the only report I have received; namely, from Captain Gray. I hope to hear from some others within a few days. I expected a very careful report from O. P. Floyd, who was one of our best farmers and a very painstaking man, but he died about the time the wheat was harvested. I regret very much the delay in this matter, but I could not help it.

Very truly yours,
C. L. SMITH.

SECOND DISTRICT.

Variety of wheat tested, "Lancaster."

Quality of seed was good.

Sowed 1 bushel per acre November 8th., on tough, white oak soil, prepared in the usual way. Condition of soil at time of sowing was very wet. Corn was growing on the land in 1887. Yield 50 bushels per acre. In 1886 in grass, in 1885, grass. Soil is considered medium. Wheather following sowing was very wet. Stand of wheat secured in the fall was thin. Crop stood frost very well, best of any I had. Crop grew tall. Ripened July 4th. Yield 19 bushels per acre.

I think it a good wheat.

JNO. B. GRAY,
Fairmont, W. Va.

RECEPITULATION FOR THE SECOND DISTRICT.

"NAIL CLUB."

Considered the best wheat ever grown.

"SOLID GOLD."

Considered excellent for high, thin land.

"MICHIGAN BRONZE."

Better than either "Fultz" or "Pool."

"LANCASTER."

Considered a good wheat.

	24	tests were sent to this district, of which
	4	were reported upon as follows:
"Nail Club."	1	report favorable.
	0	reports unfavorable.
"Solid Gold"	1	report favorable.
	0	reports unfavorable.
"Michigan Bonze"	1	report favorable.
	0	reports unfavorable.
"Lancaster."	1	report favorable.
	0	reports unfavorable.

THIRD DISTRICT.

Variety of wheat tested "German Amber."

Quality of seed received was very good.

Sowed 1¼ bushels November 1, 1888, on yellow clay soil, prepared by plowing in the wheat with a shovel plow. The ground was too wet to use another plow. The condition of soil at time of sowing was not at all good, being too wet. The land in 1887 was in corn. Yield 50 bushels per acre. In grass the year before. The soil is considered a very good clay for wheat. Weather following sowing was rather rainy. No hard freezing during the winter. Stand secured in the fall was very good, but scarcely made a show before March. So far as I was able to observe there was no fly, rust, or anything, to interfere with or attack the wheat. It stood the winter well, and I will sow it this fall. It grew vigorously the whole spring. Ripened July 4th. Yield nineteen bushels. It is a splendid wheat, in my opinion, for this locality. A number of persons inquired as to the name of the wheat, and admired it from first to last. Think it an excellent, hardy wheat. Yield big, but the fall was so wet that I was delayed in sowing more than a month. It ought to be sown in October or September. I intend to sow 10 bushels in bottom land the present month.

D. BASSEL,
Lost Creek, Harrison county, W. Va.

Variety of wheat tested "Purple Straw."

Quality of seed good.

Sowed 1¼ bushels per acre October 31st, 1888, on red clay soil prepared by plowing the wheat in with a shovel plow. Weather

wet at time of sowing. The land in corn in 1887. Yield 50 bushels per acre. In 1886 and 1885 in grass. Soil is considered a good, stiff, red clay, adapted to wheat. Weather following sowing was rather wet, and stand of wheat secured was poor, as it could not be seen until March. In April, the fly was in it to some extent. It was not a fair test; it being sown so late. Noticed nothing peculiar about the growth of crop. It ripened from 4th to 7th of July. Yield 14 bushels per acre. It is the old blue stem wheat that was raised in this country thirty years ago, and was a fine variety of wheat, but it run out and failed utterly. Forty years ago, it was considered the best wheat grown in this country. I believe it will be a success at this time sown on new upland. The truth is, that the fall was so wet, that it was not sown at the proper time and no fair test was made.

D. Bassel.
Lost Creek, Harrison county, W. Va.

THIRD DISTRICT.

Variety of seed received "Purple Straw."

Quality of seed was not good. Mixed with Cockle and Rye.

Sowed $1\frac{1}{4}$ bushels per acre on light clay soil October 31., 1888. Soil was prepared by plowing well. Ground was in good condition; though very wet at time of sowing. It was sod grown, and had been for 12 years. The soil is considered not adapted to wheat. The weather following time of sowing was rainy. The stand of wheat secured in the falir was fair. Froze out some in the winter. Its ability to withsand frost is not good. No special peculiarities noticed. Time of ripening July 1st. Yield 5 bushels per acre. I did not receive the seed in time to give it a fair test. Did not receive it until the 1st., of October. I believe the wheat is good, if given a fair chance.

W. Prunty,
Goff's, Ritchie County, W. Va.

RECAPITULATION FOR THE THIRD DISTRICT.

"GERMAN AMBER."

Considered an excellent wheat.

"PURPLE STRAW."

Believed to be a good wheat.

	72 tests were sent to this district, of which
	3 were reported upon as follows:
"German Amber."	1 report favorable.
	0 reports unfavorable.
"Purple Straw"	2 reports favorable.
	0 reports unfavorable.

FOURTH DISTRICT.

Variety of wheat tested, "Golden Amber."

Quality of seed received, fair.

Sowed 1¼ bu. per acre Oct. 11th 1888. The soil is river bottom, clay loam, prepared by two-horse plow and harrowed. The condition of the soil at time of sowing was not good. Plowed well, but was wet when sown. In 1887, the land was in clover. In 1886 in clover. In 1885 in wheat. Yield 15 bu. per acre. Soil is considered good for wheat. Weather following sowing was cold and wet. The stand secured in the fall was tolerably good. The crop withstands frost and drought well. It grows very tall, with long, white heads. Ripened July 1st. Yield 23½ bu. per acre. It is very tall wheat, with strong straw. Stands wind well. I consider it a very good wheat.

PHILIP W. WELLS,
Long Reach, Tyler Co., W. Va.

FOURTH DISTRICT.

Variety of wheat tested, "Velvet Chaff."

Quality of wheat, fair.

Sowed 1½ bu. per acre October 11th, 1888. Soil, river bottom, clay loam, prepared by two-horse plow and harrow. It was a good chance for wheat. The soil was good, but at time of sowing it was wet. In 1887, it was in clover. In 1885, in wheat. Yield 15 bu. per acre. Soil is considered good for wheat. It was sown broadcast. Stand secured in the fall was tolerably good. Wind blew one-third of it down two weeks before harvest. Stands frost and drought well. Peculiarities of growth—Dark green blades, with velvet chaff. Very tall. Ripens july 1st. Yield 32 bu. per acre. I observe that it stools well. Is very early to be sown the time it was. The grain is an average. I think it is a very good wheat.

PHILIP W. WELLS,
Long Reach, Tyler Co., W. Va.

FOURTH DISTRICT.

Variety of wheat tested, "Velvet Chaff."

Quality of seed only medium.

Sowed 1¼ bushels per acre, October 22, 1888, on heavy loam soil, prepared by double-shovel plow. Wheat was sown and harrowed in after sown. Weather very wet at time of sowing. In 1887, the land was in corn. Yield 70 bushels per acre. In 1886 in timothy. Yield 1½ tons per acre. In 1885, in timothy. Yield 2 tons per acre. Soil is considered medium for wheat. Weather following sowing was warm and very wet. Stand of wheat secured in the fall was fair, owing to grain of seed being small. The wheat was bitten by frost, not to injure roots, only blades.

It was pretty dry in April, and wheat seemed to do well. Peculiarities of growth—Not as rapid growth as "German Amber." Branches more, and was thicker on ground. Ripened June 23. Cut June 29. Yield 19 bushels per acre. In favor of this. It is early and good straw. Did not rust. Grain is larger than that of seed sent and seems to be very much improved. All like it that see it. Think it a good wheat. It seem to be harder than "German Amber."

W. H. HENDERSON,
Long Reach, Tyler Co., W. Va.

FOURTH DISTRICT.

Variety of seed wheat tested, "German Amber."

Quality of seed was good.

Sowed 1¼ bushels per acre, October 2, 1888, in heavy loam soil, prepared by double-shovel plow and harrowed in. Soil at time of sowing was very wet. Land produced 70 bushels corn per acre in 1887. In 1886 timothy. Yield 1½ tons per acre. In 1885 two tons timothy per acre. Land is considered medium for wheat. Weather following sowing was warm and very wet. Stand of wheat secured in the fall was only medium. Did not branch much. Bit by frost in April, although not enough to injure it. Some rust in June. Weather pretty dry in April, and wheat seemed to do well. Pecularities of growth—Grew slow until May, then commenced growing and branching and grew very fast. Ripened first of July. Cut on the 4th. Yield 17½ bushels per acre. Think it was owing to the late sowing that the wheat did not branch until May. I think it a good wheat. The berry is large and of good quality.

W. H. HENDERSON,
Long Reach, Tyler Co., W. Va.

FOURTH DISTRICT.

Variety of wheat tested "Michigan Bronze."

Quality of seed was good.

Sowed 1½ bushels per acre October 18, 1888. Soil is a light, sandy clay, prepared by being cultivated in corn during the preceding summer. Wheat was sown on corn stubble, and plowed in with a double shovel plow. Soil at time of sowing was very wet. Land in corn in 1887. Yield 15 bushels per acre. In 1886 in oats. Yield 8 bushels per acre. In 1885 in corn. Yield 10 bushels per acre. Soil is considered very poor and unproductive. Weather following time of sowing was wet and cold. Stand of wheat secured in the fall was very inferior, caused by late sowing and bad weather. No accidents to the crop. From time of sowing to harvest weather was wet and warmer than usual.—Ripened July 3rd. Yield 9 bushels per acre. It rained almost continually during the seeding time, and it was with great diffi-

culty that I succeeded in getting the wheat sown. It was put in in very bad condition. I consider this a very good wheat, and was surprised that it yielded as much as it did under the very unfavorable circumstance under which it was sown, and the difficulties it encountered.

D. D. JOHNSON,
Long Reach, Tyler county, W. Va.

FOURTH DISTRICT.

Variety of wheat tested "Solid Gold."

Quality of seed was good.

Sowed 1½ bushels October 30th, 1888, on chestnut oak soil prepared by being cultivated in corn the preceding summer. Wheat was sown in corn stubble, and plowed in with a double shovel plow. It was very wet at time of sowing; so wet that it was almost impossible to do the seeding. The land in 1887 had nothing on part. Tobacco and potatoes on part. In 1886, uncleared. Soil is considered poor and unproductive. Weather after sowing was very wet and cold. The stand of wheat secured in the fall was very inferior, caused principally by late sowing and bad weather. The whole season was very warm and wet. The wheat did remarkably well. The wheat grew poorly until spring, when it made a fine growth. Ripened July 6th. Yield 10 bushels per acre. I consider this a very good wheat, and under favorable circumstances and in good soil, I believe it would yield 25 bushels per acre of good hard wheat.

D. D. JOHNSON,
Long Reach, Tyler county, W. Va.

FOURTH DISTRICT.

Variety of wheat tested "Nail Club."

Quality of seed good.

Sowed 1 3-5 bushels per acre November 5, 1888, on heavy clay soil, prepared by being cultivated in tobacco the preceding summer. The wheat was sown and plowed in with a double shovel plow. soil at time of sowing was wet. In 1887 the land was in tobacco. Yield 800 pounds per acre. In 1886 uncleared woods. Soil is considered good. Weather after sowing was wet and cold. Stand of wheat secured in the fall was not very good on account of the lateness of the sowing. From sowing to reaping the weather was very wet and warmer than usual. Peculiarities of growth of crop—dark green color and "stooled" well, making a vigorous growth in the spring. Ripened July 9th. Yield 19 bushels per acre. This wheat has a remarkably stiff straw, and stands up well. All three of the samples sent to me were sown on very high ground and under very unfavorable circumstances. I consider the "Nail Club" decidedly the best and most productive wheat I ever saw. I am now sowing a 10 acre field of river

bottom land in this wheat, and expect a yield of at least 30 bushels per acre.

D. D. Johnson,
Long Reach, Tyler county, W. Va.

FOURTH DISTRICT.

Variety of seed tested "Solid Gold."

Quality of seed was good.

Sowed 1¼ bushels per acre October 31, 1888, on dark clay soil prepared by plowing with an ordinary plow, and harrowed in with ——— harrow. Condition of soil at time of sowing was not good, as it was too wet. In 1887 the same land was in oats. Yield 20 bushels per acre. In 1885 and 1886 in grass. Soil is considered ordinary. Stand of wheat secured in the fall was only moderate. Crop was hardy and no diseases appeared. It withstood frost and drought better than adjoining fields. Growth of crop was fair for the season. Ripened about June 28th. Yield 10 bushels per acre. In my opinion, this will be fine wheat for this country when fully developed or given a fair chance.

S. Mayfield,
Middlebourne, Tyler county, W. Va.

RECAPITULATION FOR THE FOURTH DISTRICT.

"GERMAN AMBER."

Considered a good wheat.

"VELVET CHAFF."

Considered a very good wheat.

"MICHIGAN BRONZE."

Considered a good wheat.

"SOLID GOLD."

Considered a good wheat.
Considered a good wheat.

"NAIL CLUB."

Considered the best wheat in the country.

19 tests were sent to this District, of which
6 were reported upon as follows:

"German Amber." 1 report favorable.
0 reports unfavorable.

"Velvet Chaff,"	1 report favorable.
	0 reports unfavorable.
"Michigan Bronze,"	1 report favorable.
	0 reports unfavorable.
"Solid Gold,"	2 reports favorable.
	0 reports unfavorable.
"Nail Club,"	1 report favorable.
	0 reports unfavorable.

FIFTH DISTRICT.

Variety of wheat tested, "Michigan Bronze."

Quality of seed was good.

Sowed 2 bushels per acre, November 2nd, 1888, on thin sandy soil, corn stubble. Seed was shoveled in with double shovel plow. Condition of soil at time of sowing was very wet. Soil is considered poor for wheat. Weather following sowing was very wet. Stand of wheat secured in the fall was only tolerably good.—Ripened a little earlier than the "Fultz." Yield 6 bushels per acre. Straw was light and firm. Think it a very good wheat. It is the best I ever raised.

R. L. Barr,
Spencer, Roane Co., W. Va.

FIFTH DISTRICT.

Variety of wheat tested, "Michigan Bronze."

Quality of seed was good.

Sowed 1¼ bushels per acre, November 1, 1888, on sandy loam soil in corn stubble. Soil is not considered very good for wheat. Weather following sowing was rainy. Ripened last of June. Yield 6 bushels per acre.

Same report for "Velvet Chaff."

Both kinds of wheat are better than what we have been raising. "Fultz" has been the leading wheat here.

A. E. Rodabaugh,
Spencer, Roane Co., W. Va.

FIFTH DISTRICT.

Variety of wheat tested, "German Amber."

Quality of seed was good.

Sowed 1¼ bushels on good soil, prepared by plowing and horrowing wheat in. Condition of soil at time of sowing was wet. Stand of wheat secured in the fall was not good. Think this wheat is only adapted for low or swamp land. We have tried it before. Ripened 8 to 10 days later than other wheat. Yield light.

This is a good wheat for low or swamp lands and produces an

excellent quality of bread. It is not snow white, but the quality of the bread is first class.

H. DePue,
Spencer, W. Va.

FIFTH DISTRICT.

Variety of wheat tested, "Velvet Chaff."

Quality of seed good.

Sowed 1¼ bushels per acre, October 15, 1888, on clay and sandy soil, prepared by plowing and harrowing. Condition of soil at time of sowing was wet. Corn was grown on this land in 1887. Soil is considered well adapted for wheat. Weather following sowing was very wet. Stand of what secured in the fall was very good. Crop blasted about the time of ripening. Withstand frost and drought well. Ripened about the same time as "Fultz" wheat. Yield 6 bushels per acre. I do not think this variety of wheat is good.

H. DePue,
Spencer, W. Va.

FIFTH DISTRICT.

Variety of wheat tested, "Gold"

Quality of seed was good.

Sowed 1¼ bushels per acre, October 28, 1888, on clay and sandy soil, prepared by plowing and harrowing. Condition of soil at time of sowing was wet. Land was in sod 25 years. Soil is considered good for wheat. Stand of wheat secured in the fall was only moderate. Wheat was winter killed. This wheat does not withstand frost and drought. Crop grew very tall, with long head and bright, soft, yellow straw. Ripened 10 days later than other wheat. Yield 7 bushels per acre. Think it a good wheat.

H. DePue,
Spencer, W. Va.

FIFTH DISTRICT.

Variety of seed tested, "Michigan Bronze."

Quality of seed tested was good.

Sowed 1¼ bushels per acre, October 15th, on mixed clay and sandy soil, prepared by plowing and harrowing wheat in. Soil was too wet at time of sowing on account of continual rain. Land had been in sod for 25 years. Considered well adapted for wheat. Wheat was blasted in head about the time of ripening. Ability of wheat to withstand frost and drought is good. It grows strong and vigorous, with good, strong, healthy straw. Yield was 8 bu. per acre. Think this a good wheat for this section with a fair chance.

H. DePue,
Spencer, W. Va.

FIFTH DISTRICT.

Variety of wheat tested, "Michigan Bronze."

Sowed 1 bushel on ¼ acre of upland, loamy soil, prepared by shoveling grain in with shovel plow. Condition of soil at time of sowing was wet, and continued wet until harvest. Crop was damaged some in the head before harvest by wet weather. Yield 5½ bushels.

C. C. KELLY.
Spencer, W. Va.

RECAPITULATION FOR THE FIFTH DISTRICT.

"MICHIGAN BRONZE."

Considered good.
Considered good.
Damaged in the head.
Considered good.

"GERMAN AMBER."

Good for low lands.

"VELVET CHAFF."

Considered good.
Considered good.

"SOLID GOLD."

Considered a good wheat.

Twenty-six tests were sent to this district, of which eight were reported upon as follows:

"Michigan Bronze,"	3 reports favorable.
	1 report unfavorable.
"German Amber,	1 report favorable.
	0 reports unfavorable.
"Velvet Chaff,"	2 reports favorable.
	0 reports unfavorable.
"Solid Gold,"	1 report favorable.
	0 reports unfavorable.

SIXTH DISTRICT.

Variety of wheat tested, "Findlay."
Quality of seed received was good.
I sowed 1¼ bushels per acre, on October 22, 1888 Soil is a light,

sandy hill-land and was prepared by drilling in corn land with 200 pounds of Anchor Brand fertilizer per acre. Condition of soil at time of sowing was a little wet, but otherwise in good condition. Raised a good crop of corn. Land considered good for corn or wheat. Weather following was very wet. Stand of wheat secured in the fall was good. I believe it a good variety to withstand frost or drought. It is a few days later than the "Rice" or "Booten." Ripened about June 20. Yield 23 bushels per acre. I think it a good, hardy wheat and a good yielder.

R. M. Simms,
Scary, Putnam Co., W. Va.

SIXTH DISTRICT.

Variety of wheat tested, "Rice."

Quality of seed was good.

Sowed 1 bushel per acre, October 22, 1889, on light, sandy hill land. Prepared by sowing in corn land with drill and 200 pounds of Anchor Brand fertilizer used to the acre. Soil at time of sowing was wet and in good condition. The soil is considered good for corn or wheat. Weather following sowing was very wet. Stand of wheat securcd in the fall was good. Ability of the crop to withstand frost and drought good. It ripened 3 or 4 days earlier than other varieties. Yield 4 bushels per acre. Think it a good, hardy, plump wheat, but not much of a yielder. It was sown side by side of "Findlay" and "White Booten," all on same soil.

R. M. Simms,
Scary, W. Va.

SIXTH DISTRICT.

Variety of wheat tested, "White Booten."

Quality of seed was good.

Sowed $1\frac{1}{4}$ bushels to the acre, October 20, 1888, on sandy, hill land, prepared by sowing broadcast and plowing in, with 200 pounds of fertilizer per acre. Condition of soil at time of sowing was wet. Had raised good potatoes upon the land. It is considered good corn or wheat land. Weather following the sowing was very wet. Stand of wheat secured in the fall was very good. Ability of wheat to withstand frost and drought is very good. Ripened June 20. Yield 14 bushels per acre. Believe to be a very good wheat.

R. M. Simms,
Scary, Putnam Co., W. Va.

SIXTH DISTRICT.

Variety of wheat tested "Findlay."

Quality of seed received was good.

Sowed $1\frac{1}{4}$ bushels per acre November 1, 1888, on a black clay

soil, prepared by harrowing corn stubble and drilling. Condition of soil at time of sowing too wet. Did not have time to turn it. Soil is considered good. Weather following was so wet, did not secure a stand in the fall thick enough. The heads were a little damaged. They filled at bottom, but near the point were not well filled. Last winter was not a fair test of its ability to withstand frost and drought. It did not have time to branch out. Ripened June 26th. Yield 8 bushels per acre. I had been sowing Lancaster on the same land some years before. Yield was about 10 bushels per acre. The grain is harder or firmer than either of the other varieties, but I do not know whether it is well adapted to our country or not.

J. F. CHAPMAN,
Hurricane, Putnam county, W. Va.

SIXTH DISTRICT.

Variety of wheat tested, "White Booten."

Quality of seed was good.

Sowed $1\frac{1}{4}$ bushels on November 1, 1888. Soil was black, heavy and prepared by light plowing and harrowing in. At time of sowing, it was a little too wet. Soil is considered good for corn. Weather following sowing was rainy, and the stand of wheat secured in the fall was tolerably good. It was sown too late to branch. We had an uncommonly mild winter; but little freezing. Time of ripening, June 25th. Yield 6 bushels per acre. I think that upon fresh clay soil, high land, the quality of the grain would be nice, but do not think the yield would be large.

J. F. CHAPMAN,
Hurricane, Putnam county, W. Va.

SIXTH DISTRICT.

Variety of seed wheat tested, "Rice."

Quality of seed received was good.

Sowed $1\frac{1}{4}$ bushels per acre November 1, 1888, on heavy loam soil. It was prepared by harrowing corn stubble, and put in with drill. The condition of the soil at time of sowing was too wet. Stand of wheat secured in the fall was tolerably good. It was very weedy, as the land was not fallowed. Last winter was uncommonly mild. The crop grows very tall; about five feet. Some stalks I measured were $5\frac{1}{2}$ feet. Time of ripening was June 20th. Yield was 10 bushels per acre. I think it a very good wheat. I could not give it a fair test last fall as I did not get the wheat in until late and it rained almost all fall, and was sown too late to branch. I have just threshed and could not report sooner.

J. F. CHAPMAN,
Hurricane, Putnam county, W. Va.

SIXTH DISTRICT.

Variety of wheat tested, "Rice."

Quality of seed received was good.

Sowed 1¼ bushels per acre, November 1, 1888 on alluvial clay soil, prepared by running a disk harrow over corn stubble and followed by drill. Soil at time of sowing was rather heavy from previous incessant rains. Land produced 50 bushels corn per acre in 1887. In 1886 and 1885 clover pasture. The soil is considered favorable for wheat. Weather following sowing was wet and cold. Stand of wheat secured in the fall was fair. Incessant rains while the wheat was in shock impaired the quality. Winter was too mild and moist to determine as to the ability of the crop to withstand frost and drought; the soil not being dry since the wheat was sown. It grows with a strong, stiff straw, and a foot taller than Findlay and Mediterranean which grew on either side of it. Ripened June 24th. Yield 16 22-60 bushels per acre. I think the wheat a good variety. Did not tiller out as well as the "Findlay;" consequently did not yield as well.

J. K. THOMPSON.
Raymond City, Putnam Co., W. Va.

SIXTH DISTRICT.

Variety of wheat tested, "White Booten."

Quality of seed received was good.

Sowed 1¼ bushels per acre, November 1, 1888, on an alluvial clay soil, prepared by running a disk harrow over corn stubble followed by drill. Condition of soil at time of sowing was heavy from previous incessant rains. Land produced 50 bushels of corn in 1887. In 1886 and 1885 in clover pasture. Land is considered favorable for wheat. Weather following was wet and mild. Stand of wheat secured in the fall was good. It was attacked by rust and nearly ruined. It was a complete failure. Opinion of the wheat, no good.

J. K. THOMPSON,
Raymond City, Putnam Co., W. Va.

SIXTH DISTRICT.

Variety of wheat tested, "Findlay."

Quality of seed received was good.

Sowed 1¼ bushels per acre, November 1, 1888, on an alluvial clay soil, prepared by running a disk harrow over the corn stubble followed by drill. Condition of soil at time of sowing was rather heavy. Land produced 50 bushels corn per acre in 1887. In 1886 and 1885 in clover. Soil is considered favorable for wheat. Weather following sowing was wet and mild, and the stand of wheat secured in the fall was good. No means of testing the ability of the wheat to withstand frost and drought, as the winter was

mild and wet, and the ground has not been dry since the wheat was sown. Incessant rains while in shock impaired the quality. It is a good stiff straw of medium height. Tillered well. Ripened July 1st. Yield 18 35-60 bushels per acre. I think highly of the "Findlay." It was sown and grown under unfavorable circumstances and yet made a fair yield.

J. K. THOMPSON,
Raymond City, Putnam Co., W. Va.

SIXTH DISTRICT.

Variety of wheat tested, "Findlay."
Quality of seed was fairly good.
Sowed 1¼ bushels per acre on sandy clay soil, prepared by turning and using disk harrow. Condition of soil at time of sowing was very good. Previous crop grown (1887) was clover. Soil is considered good, and the weather following was rainy. The stand of wheat secured in the fall was very good. It was attacked by green louse with considerable injury. Ability of the crop to withstand frost and drought very good. Ripens early with good head and straw. Ripened about June 15th. Yield was 17 bushels per acre. I think it a good wheat, but did not have fair test owing to the wet weather.

JAS. STEWART,
Raymond City, Putnam county, W. Va.

SIXTH DISTRICT.

Variety of wheat tested, "White Booten."
Quality of seed sent was fairly good.
Sowed 1¼ bushels per acre October 15, 1888, on sandy clay soil, prepared by turning plow and disk harrow. Condition of soil at time of sowing was very good. Land in clover in 1887. Soil is considered good. Weather following time of sowing was rainy. Stand of wheat secured in the fall was very good, but was attacked by green louse with considerable injury. The ability of the crop to withstand frost and drought is fairly good. It ripens a little later than the "Rice.' Has short head and straw.—Ripened June 10th. Yield 15 bushels per acre. Do not think this year has been a fair test, owing to the rainy season.

JAS STEWART,
Raymond City, Putnam county, W. Va.

SIXTH DISTRICT.

Variety of wheat tested, "Rice."
Quality of seed received was good.
Sowed 1¼ bushels per acre October 15, 1888, on sandy clay soil, prepared by turning plow and disk harrow. Condition of soil at time of sowing was very good. Previous crop grown (1887) was

clover. Soil is considered good for wheat. Weather following was rainy and stand of wheat secured in the fall was very good. It was attacked by a green louse. Ability of crop to withstand frost and drought is fairly good. It grows with a good straw and well headed. Ripened June 15th. Yield 17 bushels per acre. This was not a fair test year owing to excess of rain. Think it a very good wheat.

JAS. STEWART,
Raymond City, Putnam county, W. Va.

SIXTH DISTRICT.

Variety of wheat tested, "Findlay."

Qualty of seed was good.

Sowed at the rate of 1¼ bushels per acre, November 5, 1888, on clay soil, prepared by turning over. Condition of soil at time of sowing was splendid. It had been in timothy for 6 years previous. It is considered good wheat land. Wheat was sown entirely too late and the weather following was wet and cold. Stand of wheat secured in the fall was good for the late sowing. No accidents or diseases damaged the crop. Wheat is well adapted to withstand frost and drought. Grows tall, and I think is very good wheat for dry land. Ripened June 25th. Yield 22½ bushels per acre. Think it a good wheat.

WILL T. COX,
Cox's Landing, Cabell Co., W. Va.

SIXTH DISTRICT.

Variety of wheat tested, "Rice."

Quality of seed was fine.

Sowed at the rate of 1½ bushels per acre, November 5, 1888, on clay soil, prepared by turning over. Condition of soil at time of sowing was excellent. Land had been in timothy for 6 years. Soil is considered good wheat land. Time of sowing was entirely too late and weather following was wet and cold. Stand of wheat secured in the fall was good for time of sowing. No accident happened to the crop. Think it will stand frost well. It grows very tall, and will do well in poor, high land. Ripened June 25. Yield 21½ bushels per acre. Grains large, but stand of wheat was not so thick as "White Booten." I think it a good wheat.

WILL T. COX,
Cox's Landing, Cabell Co., W. Va.

SIXTH DISTRICT.

Variety of wheat tested, "White Booten."

Quality of seed was good.

Sowed at the rate of 1½ bushels per acre, Nov. 6, 1888, on a dark, clay soil, prepared by turning, plowing and harrowing. Wheat

sowed with a drill. Condition of soil at time of sowing very loose and in good condition. Land in timothy hay for 6 years previous. Soil is considered good wheat land. Sown entirely too late, and the weather following was wet and cold during the fall. Stand of wheat secured in the fall was good for late sowing. No accidents or diseases damaged the crop. I think it very hardy and well adapted to rich land. Has a stiff straw. Ripened June 25. Yield 22½ bushels per acre. I find that November is entirely too late to sow wheat in this country, but the seed was delayed, and wet weather still delayed until November 6.

Opinion of wheat: splendid.

WILL T. COX,
Cox's Landing, Cabell Co., W. Va.

SIXTH DISTRICT.

Variety of wheat tested, "Findlay."

Quality of seed was good.

Sowed 1¼ bushels per acre, on November 1, 1888, on sandy soil, prepared by plowing wheat in with a double-shovel plow and harrowing the ground. Condition of soil at time of sowing was wet. Previous crop grown was corn; yield 40 bushels per acre. In 1886 and 1885 land was in timothy; yield 1 ton per acre. Soil is considered medium. Weather following sowing was wet. Stand of wheat secured in the fall was not as good as the other two varieties. No accidents or diseases damaged the crop. Think this variety not as good as the other varieties tested to withstand frost and drought. Ripened June 15. Yield at the rate of 9 bushels per acre. Growth not so vigorous as other varieties and not as early as other two. Early variety is the kind of wheat needed for this country. This wheat was sown on as good ground as the other two, but it never does as well sown on corn ground as on tobacco or potatoes.

R. ENSLOW,
Huntington, Cabell Co. W. Va.

SIXTH DISTRICT.

Variety of seed tested, "White Booten."

Quality of seed was good.

Sowed 1½ bushels per acre, November 1, 1888, on sandy loam soil, prepared by plowing and harrowing. Land produced 100 bushels potatoes in 1887. In 1885 and 1886 it was in grass, producing one ton of hay per acre. Soil is considered mediem. Weather following sowing was dry. Stand of wheat secured in the fall was good. No accidents or diseases damaged the crop. Consider ability of wheat to withstand frost and drought good. Ripened June 10th. Yield 18 bushels per acre. I think it a good variety, but was sown later than it ought to have been. On account of wet weather did not get to sow wheat until November 1.

I think if sown last of September or first of October it would ripen about June 1.

R. ENSLOW,
Huntington, Cabell Co., W. Va.

SIXTH DISTRICT.

Variety of wheat tested, "Rice."

Quality of seed was good.

Sowed 1¼ bushels per acre, on November 1, 1888. Soil is a sandy loam, prepared by plowing and harrowing. Sowed broadcast and plowed in. Previous crop grown was potatoes; yield 100 bushels per acre. In 1886 in timoty; yield 1 ton per acre. In 1885 in timothy; yield 1 ton per acre. Soil is considered medium. Weather following sowing was wet, and stand secured in the fall was good. No accidents or diseases damaged the crop. Well adapted to withstand frost and drought. No peculiarities in growth of crop noted. Time of ripening was June 8. Yield per acre was 23½ bushels. Growth of the wheat was better than the "White Booten," and finest straw that I ever saw grown on wheat. I think the variety of the wheat a good one, but it was sown later than it ought to have been. Received wheat two weeks late, then it was wet for two weeks following. Did not get to sow until November 1. Think if wheat was sown last of September or first of October it would ripen June 1.

R. ENSLOW,
Huntington, Cabell Co., W. Va.

SIXTH DISTRICT.

Variety of wheat tested, "Rice."

Quality of seed was good.

Sowed 1¼ bushels per acre, October 31, 1888, on sandy soil, prepared by plowing and harrowing and sown by drilling. Soil was in good condition at time of sowing. Land in grass in 1887; yield light. In 1886 in wheat; yield 9 bushels per acre. In 1885 in corn; yield 40 bushels per acre. Stand of wheat secured in the fall was poor. Crop grew very tall, and lodged badly. Ripened June 20. Yield 13½ bushels per acre. Do not think it a good wheat.

W. J. PARSONS,
Huntington, Cabell Co., W. Va.

SIXTH DISTRICT.

Variety of wheat tested, "Findlay."

Quality of seed was good.

Sowed 1¼ bushels per acre, October 19, 1888, on sandy soil, prepared by plowing and harrowing. Soil was in good condition at time of sowing. Land in grass in 1887. In wheat in 1886; yield

9 bushels per acre. In 1885 in corn; yield 40 bushels per acre. Weather following sowing was cold and rainy. There were no accidents or diseases to damage crop. Withstands frost and drought well and has good straw that will not lodge. Ripened June 20. Yield 16½ bushels per acre. Think it a good wheat.

W. J. PARSONS,
Huntington, Cabell Co., W. Va.

SIXTH DISTRICT.

Variety of seed tested, "White Booten."

Sowed 1 1-4 bushels per acre, October 31. Quality of seed was good. Soil was prepared by plowing and harrowing. Wheat sown with drill. Land in 1887 was in grass. In 1886 in wheat; 9 bushels per acre. In 1885 in corn; yield 40 bushels per acre. Stand of wheat secured in the fall was good, and stood up well. No diseases or accidents damaged the crop. Wheat was of good height and stiff straw. and did not lodge. Ripened June 20. Yield 18½ bushels per acre. I think it a good wheat, and well adapted to this section of the State.

W. J. PARSONS,
Huntington, Cabell Co., W. Va.

SIXTH DISTRICT.

Variety of seed tested, "White Booten."

Sowed 1 1-4 bushels per acre, November 5, 1888, on thin, sandy soil. Wheat was sown on corn stubble, plowed in with double shovel plow. Soil was very wet at time of sowing. Soil is not well adapted for wheat. Weather following sowing was cold and wet. Stand of wheat secured in the fall was very good, considering the late sowing. Peculiarities of growth of crop were short heads, but good grain. Yield 12½ bushels per acre.

On account of delay in receiving wheat, we were obliged to sow it on poor land, as our good ground was all in use; hence, do not consider it a fair test. Will try this wheat again. It looks well and strong, and think it a good wheat.

DYKE BOWEN,
Cox's Landing, Cabell Co., W. Va.

SIXTH DISTRICT.

Variety of wheat tested, "Rice."

Quality of seed was good.

Sowed 1 1-4 bushels per acre, November 5, 1888, on red clay soil, prepared by shoveling and harrowing. Condition of soil at time of sowing was fair. Crop grown in 1887 was corn; yield 30 bushels per acre. In 1886 and 1885 in clover pasture. Soil is considered fairly adapted for wheat. Weather following sowing was rainy. Stand of wheat secured in the fall was good for the late

sowing. Crop was tangled considerably on June 16, and could not be cradled without loss. Straw seemed to be weak. Not able to determine as to its ability to withstand frost and drought, as the winter was very mild and wet. Did not notice any peculiarities of growth of crop. Ripened June 25, but owing to wet weather was not cut until the 29th. Yield 11½ bushels per acre.

Have sown the 11 1-2 bushels on river bottom land that was in corn, and along side of the "White Booten," on the 8th of October. Sowed broadcast.

Think the straw of "Rice" is too weak, but am giving it another trial. May be able to give a better and more extended opinion next year.

GEORGE C. BOWYER,
Winfield, Putnam Co., W. Va.

SIXTH DISTRICT.

Variety of wheat tested, "Findlay."

The seed was cracked in threshing.

Sowed 1 1-4 bushels per acre, on November 5, on light clay soil, prepared by shoveling and harrowing. Condition of soil at time of sowing fair only. Land was in corn in 1887; yield 25 bushels per acre. In 1886 and 1885 in red clover pasture. Soil is considered not well adapted for wheat. Weather following sowing was rainy. Stand of wheat secured in the fall was not very good. Was slightly tangled June 8. Cannot say as to its ability to withstand frost and drought, as the winter was wet and open. Noticed no peculiarities of growth of crop. Cut June 29. Yield 6 bushels per acre. Soil was not as good as the other lots, and seed was considerably cracked. Was thin all through. Was not so favorably impressed with the "Findlay." as with "Booten" and "Rice," but it had not as good chance as the others. Have sown the 6 bushels along side of the "Rice." There was considerable amount of cockle in this seed.

GEO. C. BOWYER,
Winfield, Putnam Co., W. Va.

SIXTH DHSTRICT.

Variety of Wheat tested, "White Booten."

Quality of seed was good.

Sowed 1 1-4 bushels per acre, November 5th, 1888, on red clay soil, prepared by shoveling and harrowing with common tooth harrow. Condition of soil at time of sowing was only fair. Crop grown in 1887, was corn; yield about 30 bushels per acre. In 1886 and 1885 land was in red clover pasture. Soil is considered well adapted for wheat. Weather following sowing was wet. Stand of wheat secured in the fall was very good, considering the late sowing. No accidents or diseases to damage the crop. Can not say as to the ability of crop to withstand frost and drought, as

the winter was very open and wet. Noticed no peculiarities in growth of crop. Wheat ripened about June 24, but was not cut until June 29, on account of rain. Yield 15 1-2 bushels per acre. Wheat was sown too late for a fair test, although the season was favorable. Sowed the 15½ bushels October 7, 1889, on river bottom land that had been in corn. As the season was so wet, had to sow broadcast. Like the wheat from the yield of this season. If it does as well the coming season, all things being considered, will continue to sow it.

GEO. C. BOWYER,
Winfield, Putnam Co., W. Va.

RECAPITULATION FOR THE SIXTH DISTRICT.

"FINDLAY."

Good wheat.
In doubt.
Considered fair.
Considered good wheat.
Considered good wheat.
Not favorable.
Think it a good wheat.
Not considered as good as "White Booten" or "Rice."

"RICE."

Considered a good wheat, but not much of a yielder.
Think it a good wheat.
Think it a good wheat, but not so good as the "Findlay."
Think it a good wheat.
Think it a good wheat.
Do not think it a good wheat.
Think it a good wheat.
Not favorably impressed with it.

"WHITE BOOTEN."

Think it a very good wheat.
Not a good yielder.
Not favorably impressed.
Think it a splendid wheat.

SIXTH DISTRICT.

"Think it a good variety."
Think it a good wheat, and well adapted to this section.
Think it a good wheat.
Considered good.
156 tests were sent to this district, of which 24 were reported upon as follows:

"Findlay"	5 reports favorable.
	3 reports unfavorable.
"Rice"	6 reports favorable.
	2 reports unfavorable.
"White Booten"	6 reports favorable.
	2 reports unfavorable.

SEVENTH DISTRICT.

"Did not receive any wheat whatever."

JNO. H. MCCREARY.
Raleigh, Raleigh Co., W. Va.

SEVENTH DISTRICT.

37 tests sent.
No reports received favorable or unfavorable.
One notice that the wheat was not received.

EIGHTH DISTRICT.

Variety of wheat tested "White Booten."
Quality of seed received was good.
Sowed about 1¼ bushels per acre November 6, 1888 on sandy clay soil, prepared by plowing early in October. Condition of soil at time of sowing was loose, but very wet. Land was in wheat in 1887. Yield about 12 bushels per acre, 1886 in corn. Yield 30 bushels per acre. In 1885 in grass. Soil is considered reasonably well adapted to wheat. Weather after sowing was wet, and stand of wheat secured in the fall was good. No accidents or diseases damaged the crop. Had very little frosts and no drought. Growth of crop: Apparently strong and healthy. Stood up well. Ripened June 25th. Yield estimated at 16 bushels per acre. Considering time of sowing, wet condition of the ground and having been worked too hard and fed too little, I think the wheat has done well. From the present experiment, I think it a good variety.

D. M. RIFFE,
Alderson, Monroe Co., W. Va.

EIGHTH DISTRCT.

Variety of wheat tested "Rice."

Quality of seed was good.

Sowed 1½ bushel per acre about Nov. 6, 1888. Soil is a mixture of sand and clay, prepared by plowing.

Condition of the soil at time of sowing was loose, but quite wet.

Previous crop grown (in 1897) was wheat. Yield 35 bushels per acre. In 1886 corn, yield light. In 1885 in pasture. Soil is considered equally adapted to the various crops. Weather following sowing was favorable, and stand of wheat secured in the fall was good. No accidents or diseases damaged the crop. There were no droughts, and only lights frosts. Crop was equally flourishing the season through. Ripened about June 25. Estimated yield 15 bushels per acre.

Considering time of sowing, wet condition of the soil, and having been worked too hard and fed too little, I think the wheat has done well. From the present experiment, I think it a good variety.

D. M. RIFFE,
Alderson, Monroe county, W. Va.

EIGTH DISTRICT.

Variety of seed tested "Purple Straw."

Same report as "White Booten", except not quite so tall nor such large heads.

D. M. RIFFE,
Alderson, Monroe county, W. Va.

EIGHTH DISTRCIT.

Variety of seed "Purple Straw."

Quality of seed good.

Sowed 1½ bushels per acre October 12, 1888, on yellow clay soil, prepared by drilling in corn field. Condition of soil at time of sowing very wet. Land recently in wheat. Soil is considered moderately good. Weather following was very wet, and the stand of wheat secured in the fall was very good. Crop was injured some by wet weather. Crop was not injured by frost and drought. Ripened June 25. Yield 19 bushels per acre. Wheat grew well. I like it very much. Think our soil suits it splendidly. No rust nor smut to be found. The reason I sowed 1½ bushels per acre, I had no 5 peck drill. I used Zell's fertilizer. I wish you could recommend a better wheat fertilizer if you can. My objections to it are that it produces too much straw.

T. L. HAYNES,
Alderson, Monroe county, W. Va.

EIGHTH DISTRICT.

Variety of wheat tested "Rice."
Quality of seed tolerably good.
Sowed 1½ bushels per acre October 12, 1888. Soil is yellow clay prepared by drilling in corn stubble. Condition of soil at time of sowing was very wet. Land in 1887 was in wheat. Soil is considered only moderately good. Weather following sowing was very wet, and stand of wheat secured in the fall was very good. Crop was damaged some by wet weather. Not injured by drought or frost. Ripened July 1st. Yield 15 bushels per acre. Wheat grew well and looked fine all the time. I think it a very good wheat, but not as good as "Purple Straw" or "White Booten."

THOMAS L. HAYNES,
Alderson, Monroe county, W. Va.

EIGHTH DISTRICT.

Variety of wheat tested "Purple Straw."
Quality of seed was good.
Sowed 1½ bushels per acre about September 25, 1888, upon black gravelly soil, prepared by plowing, harrowing and dragging. Condition of soil at time of sowing was not very good. Too wet. Oats was grown on the land in 1887. Yield 34 bushels per acre. In 1886 corn. Yield 35 bushels per acre. Soil is considered good. Weather following sowing was rainy. Stand of wheat secured in the fall was not very good on account of oats growing in soil. Crop was injured by the fly. Can not say as to the ability of the crop to withstand frost and drought as the winter was very open and the weather wet enough. It made a very good growth; was of medium height. Ripened July 1st. Yield 15 bushels per acre. I think it a good variety of wheat. It yielded well to the amount of straw, but the samples did not come until late, and I was almost done sowing and could not give the wheat the chance I would have liked to have given it. Our entire crop was light this year; not being nearly an average, but the wheat received from you was rather better than my own seed.

LEVI CLAYPOOL,
Fort Spring, Greenbrier county, W. Va.

EIGHTH DISTRICT.

Variety of wheat tested "White Booten."
Quality of seed received was good.
Sowed 1½ bushels per acre October 12, 1888. Soil is a yellow clay, and was prepared by drilling in corn land. Condition of soil at time of sowing was wet. Land had been in wheat for three years. Soil is considered only moderately good. Weather following time of sowing was very wet. Stand of wheat secured in the fall was very good. Crop was damaged to some extent by

wet weather. There was no drought, and it was not injured by frost. Ripened June 25. Yield 20 bushels. It is very broad blade. Died early. Stood up real well and ripened very early. I expect to sow the "White Booten" this year. I like this wheat very well. I find it proof against rust; also have not discovered one grain of smut.

THOMAS L. HAYNES,
Alderson, Monroe county, W. Va.

EIGHTH DISTRICT.

Variety of wheat tested "Rice."

Quality of seed was good.

Sowed 1½ bushels per acre on September 25. Soil is black and gravelly, prepared by plowing, harrowing and dragging. Condition of the soil at the time of sowing was not very good on account of oats growing in the soil. Previous crop (1887) was oats. Yield 32 bushels per acre. In 1886 corn. Yield 35 bushels per acre. Soil considered good. Weather following time of sowing was wet. Stand of wheat secured in the fall was not very good on account of oats growing in the soil. Crop was injured by the fly. Can not say as to its ability to withstand frost and drought as the winter was open and weather wet. This wheat grew a little taller than the "Purple Straw." Ripened July 1. Yield 12½ bushels per acre. Wheat very good quality, but did not yield quite as well as "Purple Straw."

LEVI CLAYPOOL,
Fort Spring, Greenbrier county, W. Va.

EIGHTH DISTRICT.

Variety of wheat tested "White Booten."

Quality of seed was good.

Report same as "Rice."

I did not have land enough left in the field to sow all of this variety. It is a shorter strawed wheat than the others, but yields tolerably well to the amount of straw. It is a beautiful wheat in quality, but, I think, it requires rich soil.

LEVI CLAYPOOL,
Fort Spring, Greenbrier county, W. Va.

EIGHTH DISTRICT.

Variety of wheat tested, "White Booten."

Quality of seed received was good.

Sowed 1½ bushels per acre, November 12, 1888. Soil is bottom land; sand and loam, prepared by plowing, and wheat put in with drill. Time of sowing weather was wet. Land was in corn in 1887. Yield 40 bushels per acre. In 1886 and in 1885 in meadow. Yield 1 ton per acre. Weather following sowing was

wet and warm, and stand of wheat secured in the fall was good. Crop seriously damaged by overflow on the 19th of May. Ability of crop to withstand frost and drought is good. Crop grew rapidly. Ripened July 1. Not threshed. Wheat was damaged so much by overflow that I could not form anything like a difinite conclusion in regard to it.

M. Gwinn,
Green Sulphur Springs, Summers Co., W. Va.

EIGHTH DISTRICT.

Variety of wheat tested, "Rice."

Quality of seed was good.

Sowed 1½ bushels per acre Nov. 12, 1888 on bottom land, sandy loam, prepared by plowing. Wheat put in with drill. Condition of soil at time of sowing was wet. Land was in corn in 1887. Yield 40 bushels per acre. In 1886 and 1885 land was in meadow. Yield 1 ton per acre. Weather following was wet and warm. Stand of wheat secured in the fall was good. Crop was nearly ruined by rust. It rained here 34 days between May 15 and July 1. Ability of crop to withstand frost and drought is good. Grows rapidly. Ripened July 1. Not threshed. I think this wheat would suit dry upland, but it is not adapted to low land or damp localities.

M. Gwinn,
Green Sulphur Springs, Summers Co., W. Va.

EIGHTH DISTRICT.

Variety of wheat tested, "Purple Straw."

Quality of seed received was good.

Sowed 1½ bushels per acre Nov. 12, 1888, on bottom land, sandy loam, prepared by plowing. Wheat put in with drill. Land in corn in 1887. Yield 40 bushels per acre. In 1886 and 1885 in meadow. Yield 1 ton per acre. Weather following sowing was wet and warm, and stand of wheat secured in the fall was very good. Crop withstands frost and drought well. Grows rapidly. Time of ripening July 1. Not threshed. The letter notifying me that you had sent the wheat was delayed for some time; the wheat, consequently, was left lying in the depot. This accounts for the late sowing. I am satisfied that this is a good variety of wheat, and will suit this soil and climate.

M. Gwinn,
Green Sulphur Springs, Summers Co., W. Va.

EIGHTH DISTRICT.

Variety of wheat tested, "Rice."

Quality of seed was good.

Sowed 1½ bushels on three-fourths acre, Nov. 1, 1888, on worn

sandy soil, prepared by plowing oats stubble and drilling the usual way. Used 200 pounds of Zells' Commercial Fertilizer. Soil at the time of sowing was worn, and the oats badley matted on same. Oats grown on this land in 1887. Yield 20 bushels per acre. In 1886 corn. Yield 20 bushels per acre. Soil is considered good for wheat, but worn. Weather following sowing was wet. Stand secured in the fall was good. Crop was damaged by the growth of oats. It withstands frost and drought well. Ripened July 1. Yield 12 bushels per acre. Owing to adverse circumstances this was not a fair test of the wheat. Will sow same next year. Believe it to be a good wheat.

CHAS. L. DAVIS,
Fort Spring, Greenbrier Co., W. Va.

EIGHTH DISTRICT.

Variety of wheat tested "Purple Straw."

Quality of seed was good.

Sowed 1¼ bushels per three-fourths acre on sandy, clay soil, prepared by plow and harrow with 200 pounds of Zell's fertilizer drilled in. Condition of soil at time of sowing was badly worn and wet. Corn was previous crop. Yield 7 bushels per acre. The soil was considered good for wheat before worked out. Wheat was sown October 16, and the weather following sowing was wet. Stand of wheat secured in the fall was scarcely perceptible. Ability of this wheat to withstand frost and drought is extra good. Peculiarties of growth. Wonderful stooling. Ripened June 28. Yield 20 bushels per acre. With attention, this wheat would yield heavily, and can be recommended.

CHARLES L. DAVIS,
Fort Spring, Greenbrier county, W. Va.

EIGHTH DISTRICT.

Variety of wheat tested "White Booten."

Quality of seed was good.

Sowed 1¼ bushels per three-fourth acre October 14, 1888, on black, loamy limestone hillside soil, prepared by shovel plow. Sown broadcast. Condition of soil at time of sowing was wet and worn. Corn was grown on same land in 1887. Yield 25 bushels per acre. In 1886 oats. Yield 30 bushels per acre. In 1885 corn. Yield 35 bushels per acre. Soil is considered good for corn and grass. Weather following sowing was very wet. Stand of wheat secured in the fall was hardly visible on account of time and season. There were no accidents to the crop or diseases. Think it withstood frost and drought very well. Good straw on strong land. Ripened June 24. Yield 10 bushels per acre. Land had been run, and I do not consider this a fair test. With proper care, I think it would be an unusually good wheat.

CHAS. L. DAVIS,
Fort Spring, Greenbrier county, W. Va.

EIGHTH DISTRICT.

Variety of wheat tested "Rice."

Quality of seed was very good.

Sowed $1\frac{1}{4}$ bushels per acre on October 19, 1888 on good clay soil, prepared by plowing, harrowing and drilled in. Condition of soil at time of sowing was very good, but just after sowing heavy rains drowned some of the crop. Soil is considered fair for wheat. Weather following was wet. Stand of wheat secured in the fall was very good considering the wet weather. Crop stood frost well. This wheat grew about one foot higher than common wheat and some fell down. Ripened last week in June. Yield 20 bushels per acre. Think it a splendid wheat. I sowed some of it this fall.

MATHEW MANN,
Fort Spring, Greenbrier county, W. Va.

EIGHTH DISTRICT.

Variety of wheat tested "Purple Straw."

Quality of seed was very good.

Sowed $1\frac{1}{4}$ bushels per acre October 19, 1888, on good clay soil, prepared by plowing, harrowing and drilling in. Soil was in very good condition at time of sowing. Soil is considered fair for wheat. Weather following sowing was very wet. Stand of wheat secured in the fall was very good. Withstood frost well. Ripened last of June. Yield 20 bushels per acre. Think it a very good wheat.

MATHEW MANN,
Fort Spring, Greenbrier county, W. Va.

EIGHTH DISTRICT.

Variety of wheat tested "White Booten."

Quality of seed was good.

Sowed $1\frac{1}{4}$ bushels per acre October 19, 1888, on good clay soil, prepared by plowing, harrowing and drilling in. Condition of soil at time of sowing was very good. Soil is considered fair for wheat. Wheather following was wet. Stand of wheat secured in the fall was good with the exception of a small piece. Withstood frost very well. This wheat did not grow so tall as the other varieties, but stood up better. Ripened last week in June. Yield $17\frac{1}{2}$ bushels. It is a very good wheat, and a prettier wheat than the Rice.

MATHEW MANN,
Fort Spring, Greenbrier Co., W. Va.

RECAPITULATION FOR THE EIGHTH DISTRICT.

"White Booten"
"A very good wheat.
An unusually good wheat.
In doubt.
Well pleased.
Think it a very good variety."
"Purple Straw."
"Good wheat.
Produces too much straw.
Favorable.
Considered a good variety.
Good variety.
Think it a very good wheat."
"Rice"
"Splendid wheat.
Believe it to be a good wheat.
Adapted to uplands, but not to low, damp localities.
Good quality, but yield not equal to "Purple Straw," or "White Booten."
Think it a good variety."

123 tests were sent to this district, of which 16 were reported upon as follows:

"White Booten"	4 reports favorable.
	1 report unfavorable.
"Purple Straw"	5 reports favorable.
	1 report unfavorable.
"Rice"	5 reports frvorable.
	0 unfavorable.

TENTH DISTRICT.

Variety of wheat tested "Tuscan Island."
Quality of seed was good.
Sowed 1½ bushels per acre October 15, 1888, on bottom land, corn-stubble prepared by harrowing and drilling. Condition of soil at time of sowing was wet. Corn was grown on same land in 1887, yield 60 bushels. In 1886 in corn. Soil is considered well adapted for wheat. Weather following sowing was wet. Stand of wheat secured in the fall was good. The crop blew down in patches before filling out. Stood the winter well. Ripened about July 1st, yield 21 bushels per acre. Think if some of it had not blown down, it would have made 25 bushels. I consider it a good kind of wheat.

ANDREW LUNSFORD.
Weston, W. Va.

TENTH DISTRICT.

Variety of wheat tested "Red Russian."
Varietv of wheat tested "Tuscan Island."
No particulars given. Wheat not yet threshed.

E. W. SMITH, JR,
Weston, W. Va.

TENTH DISTRICT.

Variety of wheat tested, "Deitz Longberry."
Quality of seed good.
Sowed 2¼ bushels on 1¾ acres clay soil, prepared by plowing with two-horse plow. Soil was in good condition at time of sowing. In 1887 land was in corn and oats. In 1885 and 1886 in pasture. Soil is considered well adapted for wheat. Stand of wheat secured in the fall was good, but short. Noticed no accidents or diseases to damage the crop. Cannot say as to its ability to withstand frost and drought, as we had neither this year. It ripened about July 4. Yield 13 bushels per acre. I believe Deitz Longberry is a good wheat and will sow it and the "Hybrid Mediterranean" this fall. Both of these varieties have nice, bright straw and nice to handle.

E. W. SMITH, JR.,
Weston, W. Va.

TENTH DISTRICT.

Variety of wheat tested, "Hybrid Mediterranean."
Quality of seed good.
Sowed 2¼ bushels on 1¾ acres of clay soil, prepared by plowing with two-horse plow. Soil was in good condition at time of sowing. Corn and oats were grown on same land in 1887. In 1886 and 1885 the land was in pasture. Soil is considered well adapted for wheat. Weather following sowing was rainy all the time. Stand of wheat secured in the fall was short on account of being sown so late. No accidents or disease affected the crop. There was no frost or drought to test its ability in this direction. No peculiarities of growth noticed. Ripened July 4. Yield 12 bushels per acre. Think it a good wheat. Like it better than the "Reliable." The "Hybred Mediterranean" did not yield as much as "Deitz Longberry," but it is about as good.

E. W. SMITH,
Weston, W. Va.

TENTH DISTRICT.

Variety of wheat tested, "Reliable."
Quality of seed was good.
Sowed 2¼ bushels on 1¾ acres clay soil, prepared by plowing with two-horse plow. Soil was in good condition at time of sowing. Corn and oats grown on same land in 1887. In 1885 and 1886 in pasture. Soil is considered well adapted for wheat.

Weather following sowing was wet. Stand of wheat secured in the fall was very short on account of late sowing. Cannot say as to its ability to withstand frost and drought, as there was no drought or hard freezing. Ripened from the 1st to the 4th of July. Yield 11 bushels per acre. Think it a good wheat.

E. W. Smith, Jr.,
Weston, W. Va.

TENTH DISTRICT.

Variety of seed tested "Valley."

Quality of seed was good.

Sowed 1½ bushels per acre October 16, 1888, on black loam soil, prepared by a shovel plow and harrowed in. Condition of soil at time of sowing was wet. Same land was in corn in 1887. Yield good In 1886 and 1885 in sod. Soil is considered well adapted for wheat. Weather following sowing was very wet. Stand of wheat secured in the fall was good. No accident or diseases noticed. Withstands frost and drought about as other wheat. Looks a good deal like other bearded wheat. Ripened about the first of July. Yield 4½ bushels per acre. The grain of wheat I observed was long and shriveled some. My opinion of this wheat is that it is about same as other wheat usually raised in this neighborhood.

O. A. Fretwell,
Buckhannon, Upshur county, W. Va,

TENTH DISTRICT.

Variety of wheat tested "Reliable."

Quality of seed was good.

Sowed 1½ bushels per acre about October 15, 1888, on black loam soil, prepared by plowing in with shovel plow, and harrowed afterward. Condition of soil at time of sowing was wet. Part of the same land produced corn in 1887. In 1886 it was in sod. Soil is considered well adapted for wheat. Weather following sowing was wet. Noticed no accidents to crop. Withstand frost and drought about as well as other wheat. Ripened July 1st. Yield 4½ bushels per acre. Grains are plump and full. I have sown 2½ bushels of this wheat this fall, as I think it worthy of another test. I think the grains are some larger and nicer looking than other wheat that I have raised.

O. A. Fretwell,
Buckhannon, Upshur county, W. Va.

TENTH DISTRICT.

Variety of seed tested "Reliable."

Quality of seed was good.

Sowed 1¼ bushels per acre October 15th., on red clay soil. Ground was prepared by plowing with a big plow. Sowed the

wheat broad cast and harrowed it in. Condition of soil at time of sowing was wet. Land in 1887 was in wheat. Yield not very good. In 1885 and 1886 in corn. Yield good. Soil is considered well adapted for wheat.. Weather after sowing was very wet. Stand of wheat secured in the fall was very good. No accidents out-except that it was a hard season on wheat. Ability to withstand frost and drought is as good as any other wheat. Noticed no peculiarities of growth. Ripened July 6th. Yield about ten bushels to the acre. It is a bearded wheat, and is a heavy, large grain. I intend to sow some of it this fall as a further test. Think it a good wheat. It seems to be hardy, and looks nice.

SILAS H. BAILEY,
Buckhannon, Upshur county, W. Va.

TENTH DISTRICT.

Variety of seed tested "Valley."

Quality of seed was good.

Sowed 1½ bu. per acre on October 10th, on clay soil, prepared by plowing with large plow, and put in with harrow. Condition of land at time sowing was good. Same land produced a good crop of corn in 1887. In 1885 and 1886 in woods. Soil is considered well adapted for wheat. Weather following sowing was wet. Stand of wheat secured in the fall was good. Frequent freezes during winter killed crop, but not more so than other varieties. Noticed nothing peculiar in growth. Ripened July 1st to 10th. Yield 3 bushels per acre. Think it a good wheat, and have sown my whole raising for a second test.

G. A. NEWLON,
Buckhannon, Upshur county, W. Va.

TENTH DISTRICT.

Variety of seed tested "Red Russian."

Quality of seed good.

Sowed 1½ bushels on dark loam soil, prepared by plowing ground with large iron plow, then sowed the wheat broadcast and harrowed it in. Condition of soil at time of sowing was very wet. Previous crop grown in 1887 was corn. Good crop. In 1886 and 1885 in sod. Soil is considered good. Weather following was very wet all fall and winter. Stand of wheat secured in the fall was good considering the lateness of sowing. Considered the crop badly winter killed by freezing, thawing, etc. Withstands frost and drought about as well as any other wheat. Ripened about July 10th. Yield 4 bushels per acre. This wheat was sown in bottom land, and the season was wet, with several hard freezing and thawing spells of weather. Think it has been the most unfavorable season that I have ever known. Think it a very good kind of wheat. Grains are large and nice looking.

THOS. J. FARNSWORTH,
Buckhannon, Upshur county, W. Va.

TENTH DISTRICT.

Variety of wheat tested "Red Russian."

Quality of seed was mixed, bearded and smooth.

Sowed 1½ bushels per acre on upland in 1888, on good clay soil, prepared by plow and harrow. Condition of soil at time of sowing was wet and almost muddy. Land was in corn in 1887. Yield 50 bushels per acre. In 1886 and 1885 in grass. Soil is considered good for wheat. Weather following sowing was very rainy. Stand of wheat secured in the fall was not good. Spring was very wet and wheat did not fill well. Ability of crop to withstand frost and drought is good. It grows some taller and is some later in ripening than other varieties and was quite uneven. Ripened July 4, and some later. Yield only 3 bushels per acre. It had no fair trial, as it was sown too late and was too wet. Was put in with drill, but no fertilizer was used. Do not think it as good as the "Fultz." The "Fulcaster" wheat has the reputation of being the best kind known, but have none in this country.

D. D. Farnsworth,
Buckhannon, Upshur county, W. Va.

TENTH DISTRICT.

Variety of seed tested "Fultz."

Quality of seed was good.

Sowed about 1½ bushels September 25, 1888, on clay soil, prepared by drilling in after corn. Condition of soil at time of sowing was wet. In 1887 the land was in corn. In 1886 and 1885 in sod. Soil is considered well adapted for wheat. Weather following time of sowing was very wet. Stand of wheat secured in the fall was tolerably good. Observed no accidents or diseases to crop. Withstands frost well. Have had no droughts. Crop grows strong and healthy. Ripened July 6. Yield 16 bushels per acre. I consider it a good quality of wheat, and hardy.

Levi Leonard,
Buckhannon, Upshur county, W. Va.

TENTH DISTRICT.

Variety of seed tested "Reliable."

Quality of seed received was good.

Sowed 1½ bushels per acre October 10, 1888, on red loam soil, prepared by plowing in with shovel plow. Condition of soil at time of sowing was a little wet. Same land produced corn in 1887. In 1886 wheat. In 1885 corn. Soil is considered well adapted for wheat. Weather following sowing was very wet. Stand of wheat secured in the fall was good. No accidents, diseases or other damages to crop. Withstands frost and drought well. It heads unevenly. Was a little late in ripening. Yield, 9 bushels per acre. Weather was wet and bad all winter, with some hard

freezing on open ground. Spring was very wet. I think we have had about as hard winter for wheat as I have ever seen. Wheat yielded as well as the "Fultz" wheat that I sowed in the field and same kind of soil.

P. M. TALBOT,
Ruraldale, Upshur county, W. Va.

TENTH DISTRICT.

Variety of wheat tested, "Reliable."

Quality of seed was good.

Sowed 1¼ bushels per acre, Oct. 10, 1888, on black hill-side soil, prepared by plowing in with shovel plow. Condition of soil at time of sowing was wet. In in 1887 the same land was in corn. In 1886 in corn. In 1885 in sod. Soil is considered well adapted for wheat. Weather following sowing was very wet. Stand of wheat secured in the fall was moderately good. Crop was hurt some by wet weather. Noticed no accidents or diseases to damage the crop. Withstand frost and drought as well as any other wheat. No peculiarities of growth of crop. Ripened about July 4. Yield 7 bushels per acre. We have had an open, wet, hard winter on wheat. It is a nice looking wheat, and about as hardy as any that we have in this section. The "Fultz" may be a little better.

HENRY BRAKE,
Buckhannon, Upshur Co., W. Va.

TENTH DISTRICT.

Variety of seed tested, "Fultz."

Qualty of seed was good.

Sowed 1¼ bushels, Nov. 4, 1888, on clay soil, prepared by plowing in with a shovel plow. Condition of soil at time of sowing was tolerably wet. Same land was in corn in 1887. In 1886 in sod. In 1885 in sod. Soil is considered well adapted for wheat. Weather following time of sowing was very wet. Stand of wheat secured in the fall was good. No accidents or diseases damaged the crop. Ability of wheat to withstand frost and drought is abont the same as other wheat grown in this section. Noticed no peculiarities of growth of crop. Ripened about July 1. Yield 11 bushels per acre. Wheat looked nice after it was threshed, and I think it is as good as any I have raised for years. Think it as well adapted to our soil and climate as any variety that we have in this section, and likely the best.

J. S. MORRISSETTE,
Lorentz, Upshur Co., W. Va.

Variety of seed tested "Red Russian."

Quality of seed was good, but mixed. One-fourth of it was bearded wheat. Sowed 1 bushel per acre about October 8, 1888, on red clay soil, prepared by sowing broadcast and plowed in with a plow (shovel). Soil at time of sowing was rather wet. In 1888 land was in corn. In 1886 and 1885 in sod. Soil is considered well adapted for wheat. Weather following sowing was very wet, and stand of wheat secured in the fall was good. Noticed no accidents or diseases to damage the crop. Stood frost well. Have had no dry weather since wheat was sowed. I noticed that the blade and stalk of this wheat were stronger than other wheat close by. Ripened about July 5. Yield 17 bushels per acre. The season has been very bad on wheat. We have had some hard freezing, and a great deal of rain. I consider it a good wheat. Grain is large and plump. I have sowed 7 bushels of it as a further test. Think it well adapted to our soil if properly put in.

G. L. CRITES
Hinklesville, Upshur county, W. Va.

RECAPITULATION FOR THE TENTH DISTRICT.

"Fultz."

"Considered well adapted to the country.
Good quality of wheat, and hardy."

"Hybrid Mediterranean."

Think it a good wheat, but it did not yield as much as "Deitz Longberry."

"Red Russian."

"Considered a good wheat.
Do not think it as good as the "Fultz."
Think it a very good wheat.
Not threshed."

"Deitz Longberry."

"Believe it to be a good wheat."
"Reliable."
"Not equal to the "Fultz."
About equal to the "Fultz."
Think it a good wheat.
Think it worth another test.
Think it a good wheat."

"Valley."

"Think it a good wheat. About the same as other wheats raised in the same neighborhood."

"Tuscan Island."

"Considered a good wheat."

64 tests were sent to this district.

15 reported upon, as follows:

"Fultz."	2 reports favorable.
	0 reports unfavorable.
"Hybrid Mediterranean."	1 report favorable.
	0 reports unfavorable.
"Red Russian."	2 reports favorable.
	2 reports unfavorable.
"Deitz Longberry."	1 report favorable.
	0 reports unfavorable.
"Reliable."	4 reports favorable.
	1 report unfavorable.
"Valley."	1 report favorable.
	0 reports unfavorable.
"Tuscan Island."	1 report favorable.
	0 reports unfavorable.

ELEVENTH DISTRICT.

But one sample of wheat was sent out, two experiments, and it was not heard from.

TWELFTH DISTRICT.

Variety of wheat tested was "Valley."

Quality of seed was good."

Sowed 1¼ bushels per acre October 25th on corn land, prepared by harrowing and shovel plow. Condition of soil at time of sowing was good. Land was new and hill land. Weather following sowing was dry. Stand of wheat secured in the fall was good. Chinch bug damaged it slightly. Crop withstands frost and drought very well. Grows just about the same as other wheat. Ripened July 8. Yield 9¼ bushels per acre. Think it a very good quality of wheat, and suits this section very well.

JAMES MALONE,
Patterson's Depot, Mineral county, W. Va.

TWELFTH DISTRICT.

November 11, 1889.

MR. JOHN A. MYERS,

Dear Sir:—The sample of wheat received from the West Virginia Agricultural Experiment Station consisted of 2 bushels of "Red Russian." Quality of seed was good. I sowed wheat in the fall of 1888, October 1st, on 1 5-12 acres of bottom land. Land was in corn previous year. After taking the corn off, the ground was prepared by harrowing thoroughly, then drilled in with about 140 pounds of guano to the acre. Weather following sowing was fine. Wheat came up strong, with a luxuriant growth before winter set in. Crop stood the winter well until about three weeks before cutting, and was likely to yield 20 bushels to the

acre, but a heavy freshet came and badly flooded it, which affected both the filling and the quality. It yielded about 13 bushels per acre. Do not think it a desirable wheat for bottom land. Ripened July 1st. "Blue Stem Mediteranean" ripened at same time. Believe it would be a good wheat for up-land. Previous crops on same land yielded about 40 bushels to the acre. In 1886 land was in grass. Yield about 1½ tons per acre.

Hoping that this will be a satisfactory report, I am,

Yours truly,

M. T. DAVIS,
Alaska, Mineral county, W. Va.

TWELFTH DISTRICT.

Variety of wheat tested, not given.

Quality of seed was very good.

Sowed 3 pecks on one-half acre sandy creek soil, prepard by plowing and harrowing it. Soil was in a very good state of cultivation. Seed was sown Nov. 1st., and the weather following was very good for grain. Wheat was flooded in June, when in bloom. Think it a splendid winter grain. Do not consider this a fair test as it was flooded, and did not yield much. So far as I know, I think it is a very grood grade of wheat.

A. GRIMES,
Alaska, Mineral Co., W. Va.

TWELFTH DISTRICT.

Variety of wheat tested "Red Russian."

Quality of seed was very good.

Sowed 1¼ bushels on 132 rods Oct. 27th., 1888. Soil is light and loamy, and was prepared by single shovel plow on corn land. Condition of soil at time of sowing was dry, rough and broken up in large cakes. Soil is considered pretty fair for wheat. Weather following sowing was wet and freezing. Stand of wheat secured in the fall was very good, considering the late sowing. There were no accidents or diseases to damage the crop. I believe this wheat will stand frost and drought remarkably well. Crop grew strong and vigorous, and headed two weeks before the other wheats. Ripened July 1st., 1889. Yield 16 bushels per acre. I think it will suit this section. I like this wheat very much, and think it the wheat for this part of the country.

J. M. KELLER,
Patterson's Depot, W. Va.

TWELFTH DISTRICT.

Variety of wheat tested "Tuscan Island."

Quality of seed was very good

Sowed 1¼ bushels per acre October 20th., on heavy clay soil,

prepared by plowing harrowing and drilling in, with a dressing of barn manure. Soil at time of sowing was in good condition. Soil is considered good for wheat. Stand secured in the fall was very good. The weather was not favorable for wheat. Ripened about July 6th. Yield 15 bushels. Do not think this variety of wheat suits this part of the state.

JOHN WEBER,
Patterson's Depot, W. Va.

TWELFTH DISTRICT.

Variety of wheat tested, "Reliable."

Quality of seed was good.

Sowed 1½ bushels per acre October 15th., 1888, on slate soil, prepared by sowing on corn stubble, and put in with shovel plow. Condition of soil at time of sowing was good. Soil is considered fair for wheat. Weather following sowing was dry. Stand of wheat secured in the fall was not very good. It withstands frost and drought rather better than other varieties. Ripened about ten days earlier than others. Yield 10 bushels per acre. The only advantage that I see in planting this variety of wheat is that it is less liable to freeze out and ripens earlier than other varieties.

WILLIAM A. WAGONER,
Patterson's Depot, W. Va.

TWELFTH DISTRICT.

Variety of wheat tested. Not given.

Quality of seed was inferior in appearance.

Sowed 1 and one-half to 1 and three-fourths bushels per acre, November 1st, 1888, on warm gravelly soil, prepared by plowing, harrowing and drilling in seed. Condition of soil at time of sowing was very wet. Work was retarded by an extremely wet fall. Crop grown in 1887, not given. Yield 10 bushels per acre. Crop grown in 1886 not given. Yield 10 bushels per acre. Crop grown 1885, not given. Yield 15 bushels per acre. Soil is considered well adapted to wheat. It was sown very late in 1888. Weather following was unfavorable. Freezing and thawing alternately. Stand secured in the fall was thin and weak, on account of late sowing I suppose. There are some chinch bugs, but they were not numerous in this part of the field. Crop seemed to stand frost and drought better than other wheat. It seemed delicate and weakly at the start, but made taller and better growth, with larger and better filled heads than that along side of it. Ripened July 1st. Yield 12 to 15 bushels per acre. The soil was better adapted to wheat growing than the average of the 25 acre field in which it was grown, but not sufficiently better to account fully for the difference in yield per acre. In as much as the average on the whole field was only about 6 bushels per acre, and this part about 12 to 15 bushels per acre, I can but think it a better

wheat than the old "Lancaster," though a smaller grained and rather a brighter wheat. The straw was taller, thicker on the ground, and the heads longer and much better filled. Whole amount of product from my sowing was about 18 bushels on something over an acre.

JNO. JOHNSON,
Alaska, Mineral County, W. Va.

TWELFTH DISTRICT.

Variety of wheat tested, "Red Russian."

Sowed 1¾ bushels per acre October 1st, 1888, on gravelly clay soil, prepared by plowing twice, harrowing and drilling in 200 pounds phosphate with seed.

Previous crop grown on this land was corn.

Soil is considered well adapted for wheat.

Weather following was wet, and stand of wheat secured in the fall was good. There were no accidents or diseases to injure the crop.

Ripened about July 1st. Yield about 22 bushels per acre.

I was deceived in the appearance of this wheat, and did not thresh it in time to sow. When I did thresh it, I regretted very much that I did not see it as it was at least one-third better than the "Mediterranean" grown under same conditions.

Respectfully,

J. W. VANDIVER,
Burlington, W. Va.

TWELFTH DISTRICT.

Variety of wheat tested, "Valley." It was clean wheat.

Sowed 1½ bushels per acre October 16th, 1888, on clay loam soil, prepared by harrowing after corn was cut. Condition of soil at time of sowing was good. Same land was in pasture in 1887. In 1886 and 1885 in pasture. Weather following sowing was favorable. Stand of wheat secured in the fall was good. Lowest part of crop froze out badly. It seems to stand drought better than frost. About one third of the wheat sent was "Fultz," some "Lancaster." The rest was "Valley." Ripened about July 6th. Yield 12½ bushels. Straw was very stiff. Did not fall in wet weather. Stood straight. Believe it would be a good wheat for high land.

HENRY E. SMITH,
Patterson's Depot, W. Va.

TWELFTH DISTRICT.

PATTERSON'S CREE, W. VA., AUG. 17, 1889.

PROF. JOHN A. MYERS,
Director W. Va. Ex. Station,

DEAR SIR: The wheat sent me last autumn for distribution in this (12th) Senatorial district was received late, after many farmers

had finished seeding. There was 44 sacks containing $2\frac{1}{4}$ bushels each.

I sent 14 sacks to R. W. Gilkeson & Son, Romney, for distribution in Hampshire county. I sent 5 sacks to George E. Leps, Keyser, for distribution in the western part of this county. The remainder I disposed of as follows; the parties receiving it being all farmers, most of them living within 8 miles of this place, though some of it went to Burlington, 20 miles south. I give name and postoffice address, and will furnish results as far as I can when the grain is threshed. The wheat sown by myself was destroyed by the great flood of May 31st. My crop of 30 acres, including a sack each of Tuscan Island and Red Russian being entirely destroyed.

NAMES OF PARTIES RECEIVING GRAIN.

John Weber, Patterson's Depot, 1 sack Tuscan Island.
John Ward, Patterson's Depot, 1 sack Tuscan Island.
William Wagoner, Patterson's Depot, 1 sack Reliable.
H. E. Smith, Patterson's Depot, 1 sack Valley.
J. M. Keller, Patterson's Depot, 1 sack Red Russian.
George Short, Patterson's Depot, 1 sack Valley.
A. Grimes, Patterson's Depot, 1 sack Valley.
James Malone, Pattersen's Depot, 1 sack Valley.
J. E. Broome, Patterson's Depot, 1 sack Valley.
M. T. Davis, Alaska, 1 sack Red Russian.
Jas. H. Long, Alaska, 1 sack Reliable.
John Johnson, Alaska, 1 sack Valley.
David Vest, Alaska, 1 sack Valley.
John W. Vandiver, Burlington, 1 sack Red Russian.
J. A. Robinson, Pattersen's Depot, 1 sack Red Russian.
J. A, Robinson, Patterson's Depot, 1 sack Tuscan Island.
J. A. Robinson, Patterson's Depot, 1 sack Tuscan Island.

Eight sacks were not disposed of, and by your advice, I sold the 18 bushels contained in them, and enclose check for the proceeds as follows:

18 bushels at 95 cts	$17.20
Less freight on grain to Romney and Keyser, as per freight bills enclosed	2.10
Freight on books	.90
Check for balance enclosed	14.20
Total	$17.20

The 15 sacks of mixed seed received were too late for delivery last fall. Each sack contained three-fourths bushel, and as the most of it was light and would cover but little ground, I had some trouble in getting it taken. One sack was torn, and most of the seed lost. One sack is still on hand. I sowed one sack, which I will report later. The other sacks were distributed in March and April during my sickness, and the young men in the store did not

take the names. They remember the following, and will shorlty find out by inquiry the names of all, if possible:

Marcus Wagoner, Alaska, 1 sack.
W. A. Wagoner, Patterson's Depot, 1 sack.
H. E. Smith, Patterson's Depot, 1 sack.
J. H. Robinson, Patterson's Depot, 1 sack.
David G. Piles, Alaska, 1 sack.
George Berry, Alaska, 1 sack.

Truly, yours,

J. A. Robinson.

Note.—The freshets and other causes prevented any successful observations upon these grasses.

J. A. Myers,
Director

RECAPITULATION.

TWELFTH DISTRICT.

"Valley."
"Believe it to be a good wheat for high land."
"Think it a very good quality of wheat. Suits the soil."
"Red Russian."
"Believe it to be a good wheat for upland."
"Think it suits this section well."
"Consider it a good wheat."
"Tuscan Island."
"Do not think this variety of wheat suits this part of the State."

It should be remembered that the freshet destroyed the greater portion of the crops in some sections of this district so that reports could not be rendered.

"Reliable."
"Think it a good wheat."

Reports 1 Favorable.
0 Unfavorable.

Of the 44 tests sent out 11 reports were made. Of these 2 reports were "Tuscan Island," from which 0 reports were favorable, 2 reports were unfavorable. 3 tests of "Valley," from which 2 reports were favorable, 0 reports were unfavorable. 3 tests of "Red Russian" from which 3 reports were favorable, 0 reports were unfavorable. 1 favorable report for "Reliable," no unfavorable report. Two reports of "Variety" not given.

THIRTEENTH DISTRICT.

Variety of wheat tested, "Rice."

Quality of seed was poor and dirty.

Sowed 1¼ bushels per acre, on corn land, October 15, 1888. Soil was sandy loam, prepared by harrowing after cutting corn. Condition of soil at time of sowing was good. Corn was grown on land in 1887. Yield 17 to 18 bushels. In 1886 corn, with same yield. In 1885 same. In 1888 corn, yield 20 bushels. Soil is considered

well adapted for wheat. Weather following sowing was favorable and stand of wheat secured in the fall was good. The continued rains in spring caused blight. Can not tell as to its ability to withstand frost and drought, as the winter was very open. Crop ripened early. Yield 10 bushels. Think it would be better to get wheat from the North for this section. Cannot form any opinion of the wheat under the circumstances. Open winter and unusually wet spring and early summer.

ALBERT F. DAVIS,
Rippon, Jefferson Co., W. Va.

THIRTEENTH DISTRICT.

Variety of wheat tested, "Blue Stem" (Straw).

Quality of seed was inferior; too much garlic and cockle.

Sowed 1¼ bushels per acre, October 20, 1888, on slate and limestone soil, prepared by plowing the corn up with double-shovel plow, then drilling the wheat in. Soil was in good condition at time of sowing. Land was in pasture in 1887. Weather following sowing was fair. Wheat was frozen out very much in March, as it had a northern exposure, and scabbed very much on account of wet weather. Had no drought. Noticed no peculiarities of growth. Ripened June 26. Do not know the exact yield per acre, as I was sick when wheat was harvested, and the hands did not keep it separate. I should judge it made about 15 bushels per acre.

Think it a good wheat.

W. H. LEWIS,
Kabletown, Jefferson Co., W. Va.

THIRTEENTH DISTRICT.

Variety of wheat tested, "Purple Straw."

Quality of seed good."

Sowed 1¼ bushels per acres October 12, 1888, on loamy clay soil, prepared by spring tooth harrow in corn land. Condition of soil at time of sowing was a little damp. Corn grown season before. Yield 50 bushels. Soil is considered well adapted for wheat. Weather following sowing was cold and not conducive to germination. Stand secured in the fall was bad. No harm until heading. Had a mild winter. Crop stood the winter and spring well. Did not make a strong growth. Ripened June 30. Yield 17 bushels per acre. Owing to wet weather in June, the wheat scabbed badly. Never saw wheat scabb worse than this. I prefer to withhold my opinion until I try this wheat again, as all of our wheat was more or less affected by wet weather after it came in head.

W. O. NORRIS,
Kabletown, Jefferson Co., W. Va.

THIRTEETH DISTRICT.

Variety of wheat tested "White Booten."

Quality of seed indifferent.

Sowed $1\frac{1}{4}$ bushels October 26 on good wheat land. Weather following sowing was very wet.

White wheat cannot be grown to any profit in this country.

JNO. F. MYERS,
Charlestown, Jefferson Co., W. Va.

THIRTEENTH DISTRICT.

Variety of seed tested "Purple Straw."

Quality of seed was very good.

Sowed $1\frac{1}{4}$ bushels per acre October 26, 1888, on lime stone soil, prepared by sowing on corn land. Soil was in excellent condition at time of sowing. Soil is considered well adapted for wheat. Weather following sowing was very wet. Fine stand of wheat was secured in the fall. Rust and wet weather damaged the crop to some extent. Had no drought. Stood the frost very well. Ripened June 28. Yield 20 bushers per acre. I shall sow all that I raised next year. It will be better adapted to the soil, etc., than it was this year. I regard it as an excellent variety of wheat. I sowed it ten days later than I sowed the other varieties, and in less quantity per acre, and yet it ripened at same time and yielded better. My own varieties yielded only 15 bushels per acre. Would have had better yield, I think, if I had used high grade fertilizers. The wheat came late; consequently, I had to use a cheap, inferior grade of fertilizers, as I had sown my best grade.

JNO. F. MYERS,
Charlestown, W. Va.

THIRTEETH DISTRICT.

Variety of seed tested "Rice."

Quality of seed was good.

Sowed $1\frac{1}{4}$ bushels per acre on limestone soil. Crop was sown on corn ground. Soil is considered good for wheat. Sown October 24, 1888. Weather following sowing was wet. Stand of wheat secured in the fall was moderately good. Rust and wet weather damaged the crop. Had neither frost nor drought. Ripened June 28. Yield about 12 bushels per acre. I think it a pretty fair variety of wheat.

JOHN F. MYERS,
Charlestown, W. Va.

THIRTEENTH DISTRICT.

Variety of wheat tested "Rice."

Quality of seed good.

Sowed $1\frac{1}{4}$ bushels per acre on October 12, on fine, loamy soil, prepared by spring tooth harrow. The land being in corn was in fine condition for seeding. Condition of soil at time of sowing was very fine. In 1888 land was in corn. In 1887 in clover. Yield $3\frac{1}{2}$ bushels per acre. In 1886 and 1885 in clover. Soil is considered very fine for wheat. Weather following sowing was a

little too cool. Stand of wheat secured in the fall was very good. Have been sowing "Rice" wheat for a number of years. Crop was damaged by some wet weather. Too much straw. Wheat is very hardy, will stand drought very well. Very heavy growth of straw is the only objection to this wheat. Ripened June 25. Yield 22 bushels per acre. I have been sowing "Rice" wheat for eight years. Have always found it very hardy. More hardy than other varieties, but grows too much to straw in seasons like the last, very wet. Think it a very splendid wheat where the land is not too strong; it being always of a heavy growth, falls too much unless it is a dry season.

I sowed 10 bushels of "Tuscan Island" the same day on same kind of soil. Had a fine prospect until the wet season set in. It was very badly scabbed. Yield was 20 bushels per acre. Believe it to be a good wheat. Will try it again this fall.

C. C. Conklyn,
Charlestown, Jefferson Co., W. Va.

THIRTEENTH DISTRICT.

Variety of seed wheat tested "Purple Straw."

Quality of seed not good. Was mixed.

Sowed 1¼ bushels per acre October 12th, 1888, on fresh loam soil, prepared by spring tooth harrow. It being corn land, soil was in fine condition. Corn being thoroughly cultivated, the land was perfectly clean. Land was in clover in 1887. In 1885 in pasture. Soil is considered well adapted for wheat. Weather following sowing was favorable, a little cool. Stand of wheat secured in the fall was good. Fine stand all winter but ruined by rain in summer. Stood frost well. Had no drought. Ripened June 25th. Yield was not over 10 bushels per acre. Wheat did well until the rain set in in May or about blooming time. It was badly scabbed and finally killed by rust. The past season has been no test for any wheat. All varieties were badly damaged by rain. Do not think it a good wheat for our country. Too liable to scab and rust. Would suggest sending only one variety to one man, but in larger quantities. Small lots are too expensive to keep separately.

C. C. Conklyn,
Charlestown, Jefferson Co., W. Va.

THIRTEENTH DISTRICT.

Variety of wheat tested "White Booten."

Quality of seed received was not good.

Sowed 1¼ bushels per acre October 12th on fine loamy soil, prepared by spring tooth harrow. It being corn land, soil was in fine condition. In 1887 land was in sapling clover. In 1885 in pasture. Soil is considered very good for wheat. Weather following sowing was a little cool. Stand of wheat secured in the fall was not quite as strong as other varieties. Crop was damaged some by frost. Ruined by wet weather. Does not stand frost

well. Had no drought. Crop died off June 20th. From observations, do not think it suits our country at all. Think it a very poor wheat under any circumstances. It was killed dead with rust.

Last fall I sowed some of the old time blue stem wheat, which did very fine. Yield was 25 bushels to the acre. Very stiff straw, and believe it will be our leading wheat again.

C. C. CONKLYN,
Charlestown, Jefferson Co., W. Va.

THIRTEENTH DISTRICT.

Variety of wheat sown "White Booten."

Quality of seed was good.

Sowed 1¼ bushels per acre on limestone soil, prepared by harrowing corn ground. Condition of soil at time of sowing was good. Crop grown in 1887 was corn. Yield 50 bushels per acre. In 1886 in hay. Yield 2 tons per acre. In 1885 in clover. Yield 20 bushels per acre. In 1884 the land was in wheat. Soil is considered well adapted for corn or wheat. Weather following sowing was good growing weather for wheat. Stand of wheat secured in the fall was very good. Nothing injured the wheat except it sprouted some in the shock by rain. It stood frost and drought very well. It is of short and slow growth. Ripened the latter part of June. Yield was 17 bushels. Wheat raised was not of as good quality as the seed sown. Grains were not as white and plump, but were of a yellow cast and shriveled. I do not think the wheat suits the limestone soil, as it does not grow as tall or as rapidly as the wheat grown here.

HENRY P. BUSEY,
Gerrardstown, Berkeley Co., W. Va.

THIRTEENTH DISTRICT.

Variety of wheat sown "Rice."

Quality of seed was good, but very filthy. Had to clean before sowing. Sowed 62 pounds on three-fourth acre of corn land. Soil is a clay limestone, prepared by harrowing well, then sowed 150 pounds of fertilizer and top dressed with manure. Condition of soil at time of sowing was good. Crop grown in 1887 was corn. Yield 60 bushels per acre. In 1886 it was in wheat. Yield 25 bushels per acre. In 1885 in clover. Soil is considered good. Stand of wheat secured in the fall was good.

Peculiarities of growth of crop: Has a very stiff straw. Head of medium length. Ripened early, about the same time as the "Fultz," which yielded about 22½ bushels. This yielded 14 bushels and 30 pounds from the 62 pounds sown. Can not say a great deal about the wheat, but will sow more this fall.

JOHN W. TABB,
Gerrardstown, Berkeley Co., W. Va.

THIRTEENTH DISTRICT.

Variety of wheat tested, "Purple Straw."

Quality of seed was good.

Sowed $1\frac{1}{4}$ bushels per acre October 15th 1888, on soapstone soil, prepared by thoroughly harrowing and manuring with 200 pounds of South Carolina phosphate. Land is of good quality. Land was in clover in 1887. Yield 1 ton. In 1886 in clover. In 1885 in wheat. Soil is considered good for wheat. Crop was sown October 15th, and weather following was very unfavorable for two weeks. Stand of wheat secured in the fall was satisfactory considering time of sowing. Can not say whether crop would withstand frost or drought, as the winter was very mild and open. Peculiarities of growth of crop: Grew vigorously. Straw was exceedingly stiff. Matured early. Ripened June 25th. Yield 20 bushels per acre or 30 pounds. While the wheat in this section lodged badly this season, the "Purple Straw" stood up well and matured a beautiful berry, and is valuable on this account. Think the "Purple Straw" well suited to any locality where "Fultz" is successfully grown. The yield under favorable circumstances would probably be heavy. Am well pleased with "Purple Straw."

HALL WILSON,
Gerardstown, Berkeley Co., W. Va.

RECAPITULATION FOR THE THIRTEENTH DISTRICT.

"Purple Straw."
"Think it a good wheat."
"Uncertain."
"Uncertain."
"Think it a good wheat."
"Consider it a good wheat."
"Rice."
"No opinion formed."
"Think it a pretty fair variety of wheat."
"Uncertain."
"Uncertain."
"White Booten."
"Wheat not satisfactory."
"Very poor wheat."
"Wheat unsatisfactory."

It should be remembered that all varieties of wheat in this district suffered from the freshet and excessive rains in the spring. From the 51 tests sent into this district, 12 reports were received.

"Purple Straw."	3 reports were favorable.
	2 reports unfavorable.
"Rice."	1 reports were favorable.
	3 reports unfavorable.
"White Booten."	1 reports favorable.
	2 reports unfavorable.

The seed furnished to this district seems not to have been of the quality guaranteed by the dealers, and several of the parties receiving the seed complained that is was either badly mixed or badly cleaned. It was furnished by T. W. Wood & Son, of Richmond, Virginia.

II. FRUIT TREES AND SMALL FRUITS.

A circular letter similar to the one in regard to wheat was sent to each regent in regard to testing of fruits in their respective districts. Dr. Brown of the thirteenth district also desired to test garden seeds, potatoes, etc., and upon his requisition, the lists of seeds, etc., indicated were sent to him.

The lists of fruit trees and seed sent to the respective districts are included under the district to which they were sent.

I have since called for reports upon everything sent out, but with the exception of a letter from Major Bennett, which is herewith included, no report as to the condition of the trees has been received. We do not know how many of them perished during the summer, and it is yet too early for us to have any information in regard to their fruit. The lists of trees and shrubs are placed under each regent's name receiving the same, and also the list of garden seeds, potatoes, etc., sent to the thirteenth district.

We have failed to receive any reports of the tests of grass and forage plants sent out, which, no doubt, is in a manner due to the fact that the experiments were destroyed by the unprecedented freshets and heavy rains prevailing at the season of the year when they were started.

REPORT OF HON. E. A. BENNETT.

JNO. A. MYERS,

Director Agricultural Station :

DEAR SIR :

This section of West Virginia produces only a very limited variety of apples and small fruits. It may be said, as to the former that a single variety constitutes the apple crop. The "Rome Beauty," having originated in Rome Township, Lawrence county, Ohio, just across the Ohio River, opposite th mouth of the Guyandotte River, and being an excellent bearer and fair keeper, and really a very fine fruit, has monopolized the attention of growers to the almost total neglect of other varieties. The general prejudice in favor of this apple, is emphasized by the fact, that limited experiments with other fruits, suited to the season of the year to which the Rome Beauty is not suited, have, so far, failed, and quite an extensive trial made by a large fruit grower of Huntington about twenty years ago proved a failure as to a large proportion of the varieties planted. The demand for early and summer apples is urgent and the reward to the successful grower of them will be very great. It only remains to learn what varieties will succeed in this locality to stimulate their planting and growth,

and assure a large inscrease in the earning capacity of the farm lands in this section of the State. It is not expected that a fall and winter variety (to which the Rome Beauty belongs), will be shown that will be much superior in many respects to, or threaten the supremacy of, that famous apple; but it is believed that such will be found as will fairly equal it and supplement it in its season, and that other varieties will be found well suited in this section and which ripen in the early and midsummer, for which particular seasons we have now scarcely any varieties at all.

With this view, after correspondence with the Director of the West Virginia Agricultural Station, and with his approval of the method proposed, I determined to enter upon such and experimental trial of various fruits as will determine just which of them are suited to this climate and locality. Being supplied by the Station with a large variety of such fruits as could be hastily selected, owing to the lateness of the season when the experiment was determined upon, and having supplemented this with other varieties since provided by myself, these have been planted on an eligible tract of upland in the foot hills near the city of Huntington. The stock supplied by the Station was received near Christmas, 1888, just preceding a snow storm that came next day after its arrival and were "heeled" in, and so remained until a rather late spring brought suitable planting weather and condition of the ground. They were then planted in the following manner: The ground, newly cleared, was broken with a two-horse barshare plow to a depth of about eight inches. Holes or places for the young trees were then dug thirty feet apart each way, to the depth of eighteen inches and about three feet square. These were partially filled with surface soil from the surrounding earth. The roots of the young trees were then immersed in a mortar, composed of a small portion of stable manure, mixed with soil and water to the consistency of "batter," until they were thoroughly covered with it, and, at once, they were set out. One person held them in an upright position and "fingered" the earth about and among the roots, while a second shoveled the earth in until the holes were filled up about the trees. Care was taken to put plenty of fine dirt closely about the small roots and to keep them well straighted out as the filling in process went on, after which the earth was well stamped in about the tree with the feet to insure firmness and thorough contact of the soil with the roots.

Very soon after planting the leaves came out well on them, and only about ten per cent. have failed to grow. Even this per cent. of loss is to be attributed to the four weeks of drought that came in April. A number of the cherry trees blossomed this year, but the blossoms aborted and brought no fruit to maturity. It is worthy of note, that a larger per cent. of these died than of any other, and, it is probable, that the better practice would have been to rub off the fruit buds to prevent blooming and its consequent exhaustion of the tree. The land was cultivated in corn.

It will necessarily require several years before any considerable

number of the trees and vines thus planted will bear and mature fruit; but it is contemplated to keep the station advised of the progress of the experiment with a view to inform the general public of the most promising varieties, and, when sufficient time has elapsed to fully develop results, a detailed report ought to go out which shall serve for a guide to those requiring this class of information. If the hopes of those patronizing and forwarding the experiment are realized such information will amply repay the cost of the work and expenditure, and confirm the view entertained by them that such a concentrated method of experimentation, with the proposed reports thereof, will prove of much more value to the public than the distribution of a like number of plants in small lots where it is impossible to get reports either of progress or results.

E. A. BENNETT,
Huntington, W. Va., Oct. 1889.

LIST OF FRUIT TREES, VINES, ETC., SENT TO HON. E. A. BENNETT.

Apples.

3 Early Harvest.
3 Golden Sweet.
3 Summer Rose.
3 Chenango.
3 Gravenstein.
3 Plump Sweet.
3 Dominie.
3 Grimes Golden.
3 Monmouth Pippin.
3 Rambo.
3 R. I. Greening.
3 Tompkins King.
3 Vandevere.
3 Belleflower.
3 Early Strawberry.
3 Kes. Codlin.
3 Tetofsky.
3 Fall Pippin.
3 Jersey Sweet.
3 Canada Reinette.
3 Fallawater.
3 Mann.
3 Northern Spy.
3 Rawle's Janet.
3 Rox. Russett.
3 Twenty Ounce.
3 Wagner.
3 Tolman's Sweet.
3 Red Russian.
3 Fanny.
3 Haskel Sweet.
3 Red Beitingheimer.
3 Lady's Sweet.
3 William's Sweet.
3 Jefferies.
3 Lady.
3 Newton Pippin.

Crab Apples.

3 Paul's Imperial.
3 Coral.
3 Dartmouth.
3 Large Yellow.
3 Montreal Beauty.
3 Yellow Siberian.
3 Currant.
3 Large Red Sib.
3 Marengo.
3 Oblong.

Pears.

3 Andre Deportes.
3 Clapp's Favorite.
3 Summer Doyenne.
3 Louise Bonne.
3 Anjou.
3 Pound.
3 Bartlett.
3 Manning's Elizabeth.
3 Howell.
3 Seckel.
3 Easter Buerre.
3 Ansoult.
3 Fred. Clapp.
3 Souv d'Congress.
3 Duhamel du Monceau.
3 Becon.

Cherries.

3 Black Eagle.
3 Black Tartarian.
3 Cleveland.
3 Trancendant Black.
3 English Morello.
3 Gov. Wood.
3 Sparhawk's Honey.
3 Napoleon.
3 Early Richmond.
3 Reine Hortense.
3 Windsor.

Plums.

3 Coe's Golden Crop.
3 General Hand.
3 St. Lawrence.
3 Fellenburg.
3 Pond's Seedling.
3 De Caradem.
3 Grand Duke.

Peaches.

3 Alberge Yellow.
3 Crawford's Late.
3 Goshawk.
3 Lord Palmerston.
3 Mt. Rose.
3 Rivers E. York.
3 Schumaker.
3 Susquehanna.
3 Walburton Admirable.
3 Conkling.
3 Foster.
3 Large E. York.
3 Louise.
3 Red Cheek Mel.
3 Salway.
3 Surpasse Mel.
3 Wheatland.

Apricots.

3 Alb. de Montgamet.
3 Breda.
3 De Coulange.
3 Moorpark.
3 Red Masculine.
3 Large Early.
3 Purple.

Quinces.

3 Orange.
3 Champion.

Nectarines or Plum.

3 Boston.
3 Pitmaston Orange.
3 Lord Napier.

Grape Vines.

3 Hartford.
3 Ionia.
3 Isabella.
3 Worden.
3 Delaware.
3 Rebecca.
3 Brighton.
3 Gaertner.
3 Mrs. Princes Museat.
3 Syrian.
3 Moore's Early.
3 Monroe.
3 Rochester.
3 Red Chasselas.
3 Museat of Alexandria.
3 Mills.

Blackberries.

6 Agawam.
6 Erie.
6 New Rochelle.
6 Wilson's Junior.

Currants.

6 Prince Albert.
6 Victoria.

Gooseberries.

3 Industry.
3 Downing.
3 Pale Red.

Raspberries.

3 Brandywine.
3 Gregg.
3 Shaffer's Colossal.
3 Cuthbert.
3 Mammoth Cluster.
3 Caroline.
3 Golden Queen.

Figs.

1 Angelique.
1 Black Provence.
1 Castle Keennedy.
1 Black Ischia.
1 Brown Ischia.

Almonds.

2 Soft shell.

Chestnuts.

2 Spanish.
2 Japan.

Mulberries.

2 New American.

Walnuts.

2 English.
2 Dwarf Prolific.

These trees were reported by Mr. Hays last June as growing and doing well.

THIRD DISTRICT—PEREGRIN HAYS, REGENT.

Name.	*Residence of the Consignee.*		*Name of Variety.*	*Quantity.*
Peregrin Hays, Glenville,		Apple,	American Gold Pippin	10
same		"	Baldwin	10
same		"	Seek No Further	10
same		"	Belmont	10
same		"	Ben Davis	10
same		"	Buckingham	10
same		"	Caroline Red June	10
same		"	Danveri Winter Sweet	10
same		"	Dominie	10
same		"	Ladies' Sweet	20
same		"	Rambo	35
same		"	Rome Beauty	10
same		"	Vandevere	10
same		"	Wine Apple	10
same		"	Yellow Belleflower	10
same		"	Canada Rievrelle	6
Total				191
Peregrin Hays, Glenville,		Cherries,	Governor Wood	5
same		"	Kentish	5
Total				10
Peregrin Hays, Glenville,		Peaches,	Hale's Early	5
same		"	Early York	5
same		"	Newington	5
same		"	Crawford's Early	10
same		"	Old Mix Free	5
same		"	Norris White	5
same		"	Large White Cling	5
same		"	Old Mix Cling	5
same		"	Heath Cling	5
same		"	Crawford's Late	10
same		"	Late Red Rare-ripe	5
Total				65
Peregrin Hays, Glenville,		Currants,	Cherry	4
same		"	Goudom White	2
same		"	White Dutch	2
same		"	Knights Red	2
Total				10
Peregrin Hays, Glenville,		Pears,	Vicar Wakefield	4
same		"	Edmond	6
same		"	Stevens' Genese	3
same		"	Kieffer & Lecomb	10
Total				23
Peregrin Hays, Glenville,		Plums,	Washington	10
same		"	Damson	10
same		"	Lombard	10
Total				30
Peregrin Hays, Glenville,		Orange,	Quincy	5
same		Raspberries,	Cuthbert	5
same		"	Gregg	5
same		"	Mam. Cl	5
same		"	Philadelphia	5
Total				20

Peregrin Hays, Glenville,	Strawberries,	Sharpless	12
same	"	Triumph de Gand	12
Total			24
Peregrin Hays, Glenville,	Blackberries,	Kittatenny	6
same	Grape Vines,	Hartford	3
same	"	Isabella	3
same	"	Iona	3
same	"	Worden	3
same	"	Brighton	3
same	"	Delaware	3
same	"	Gauhrer	3
same	"	Rebecca	3
same	"	Novres Early	3
same	"	Monroe	3
same	"	Rochester	3
same	"	Princess Muscat	3
same	"	Lyrian	3
same	"	Red Chasseless	3
same	"	Muscat of Alexandria	3
same	"	Mills	3
Total			48

Varieties of Fruit and Ornamental Trees Sent to Dr. W. W. Brown—13th District.

Apples.
- 6 Yellow Transparent.
- 3 Baldwin.
- 6 Delaware Winter.
- 6 Transcendent Crab.

Peaches.
- 12 Lord Palmerston.
- 6 Wheatland.
- 6 Waterloo Globe.
- 3 Magnum Bonum.
- 3 Lemon Cling.

Pears.
- 12 Lawson.
- 6 Kieffer's Hybrid.

Cherries.
- 6 Schmidt's Bigereau.

Plums.
- 12 Kelsey's Japan.
- 12 Boton Japan.
- 12 Spaulding.
- 12 Prunus Simoni.
- 12 Prunus Pisardi.

Currents.
- 12 Fay's Prolific.

Gooseberries.
- 12 Industry.

Grapes.
- 12 Niagara.
- 12 Moore's Early.
- 12 Early Victor.
- 12 Vergennes.

Strawberries.
- 100 Parry.
- 100 Mammoth.
- 100 Manchester.

Blackberries.
- 100 Wilson's Junior.

Raspberries.
- 100 Cuthbert.

Quinces.
- 12 Champion.
- 6 Meeche's Prolific.
- 2 Arbor Vitæ Pyramidalis.
- 2 Silver Fir.
- 3 Magnolia Accuminati.
- 2 Irish Juniper.
- 2 Wier's Cut Lv'd Maple.
- 6 Figs.
- 1 Purple Beech.
- 6 Dwarf English Walnut.
- 6 Japan Chestnut.
- 3 Willow Diamond.
- 6 Japan Persimons.
- 3 Magnolia Conspic.
- 6 Russian Apricots.

III. GARDEN SEEDS.

List of Garden Seeds, etc, sent to Dr. W. W. Brown—13th District.

AMOUNT.	SEED.	VARIETY.
2 bbls.	Potatoes.	B's Superior.
20 bu.	Oats.	Welcome.
2 bu.	Corn.	Hickory King.
5 packets.	Beans.	Head Bush and L.
3 "	Beans.	Blue Podded Butter.
1 qt.	Beans.	Perfection Wax.
1 "	Beans.	Best of all Dwarf.
1 "	Beans.	King of Garden.
1 pt.	Beans.	White Creasback.
1 "	Beans.	Lazy Wife's.
1 packet.	Beans.	White Zulu.
1 "	Beet.	B's Extra Early.
2 "	Beet.	Improved Turnip.
1 "	Cabbage.	Express.
2 "	Cabbage.	Jersey Wakefield.
1 "	Cabbage.	Vandegraw.
2 "	Cabbage.	B's Surehead.
3 "	Cabbage.	Superior.
2 "	Cabbage.	Perfection Savory.
1 "	Celery.	Gold. Self Blanching.
4 qts.	Corn.	Cory.
1 "	Corn.	Amber Cream.
1 packet.	Pop Corn.	Mapledale.
2 "	Cucumber.	Peerless.
1 "	Cucumber.	Early Russian.
1 "	Cucumber.	Giant Pera.
1 "	Lettuce.	Silver Ball.
1 "	Lettuce.	Hanson.
1 "	Lettuce.	Hard Head.
1 oz.	Melon.	Emerald Gem.
1 packet.	Melon.	Perfection.
1 "	Onion.	Victoria Red.
5 "	Onion.	Red Yell. Danvers.
4 qts.	Onion.	Sets, White.
1 packet.	Onion.	Silver Skin.
3 packets.	Parsnips.	Guernsey.
1 qt.	Beans.	Orin's Improved.
1 "	Peas.	B's Extra Early.
1 "	Peas.	Quantity.
1 "	Peas.	Quality.
1 "	Peas.	American Wonder.
1 "	Peas.	Everbearing.
2 packets.	Pumpkin.	Quaker Pie.
2 "	Pumpkin.	Summer Sweet Potato.
5 "	Pumpkin.	Japanese.
3 "	Pumpkin.	St. George.

3 packets,	Radish.	Early White Turnip.
2 "	Radish.	Suprise.
3 "	Radish.	Gt. White Stuttgart.
2 "	Radish.	Earliest Turnip.
2 "	Salsify.	Sandwish Island.
2 "	Squash.	Brazil Sugar.
3 "	Squash.	Pike's Peak.
2 "	Pepper.	Ruby King.
2 "	Tomato.	Turner's Hybrid.
2 "	Tomato.	Matchless.
1 "	Tomato.	Volunteer.
2 "	Turnip.	Breadstone.
1 "	Pop Corn.	Tom Thumb.
1 "	Beans.	Earliest of All.
1 "	Pansy.	Defiance, mixed.
1 "	Phlox.	Drum. Grand, mixed.
1 "	Verbena.	Hy. Grand.
1 "	Verbena.	Musa Ensete.
1 "	Verbena.	Eutalia Japonica.
1 "		Hold's mammoth Sage.
2 "		Hydrangea Pan.
1 "		Spirea Van Houtii.
1 "	Rose.	Bon Silene.
1 "	Rose.	Etoile de Lyon.
1 "	Rose.	Mad. Margottin.
1 "	Rose.	Marie.
1 "	Rose.	Papa Gontier.
1 "	Rose.	Perles des Jardins.
1 "	Rose.	Sunset.
1 "	Rose.	Bride.
1 "	Rose.	Adam.
1 "	Rose.	Agripina.
1 "	Rose.	Annie Olivet.
1 "	Rose.	Coquette de Lyon.
1 "	Rose.	Duchess de Fl.
1 "	Rose.	Jean d'Arc.
1 "	Rose.	La France.
1 "	Rose.	Marechal Robert.
1 "	Rose.	Pierre Gollot.
1 "	Rose.	Souv. de Malmaison.

GRASSES AND FORAGE CROPS.

THIRTEENTH SENATORIAL DISTRICT.

To Dr. W. W. Brown.

1 bushel Lucerne.
1 bushel German Amber.
1 bushel Sapling,
1 bushel Red Clover.
1 bushel Alsike.

1 sack Grass Seed mixture No. 1.
1 sack Grass Seed mixture No. 2.
1 sack Grass Seed mixture No. 3.
1 sack Grass Seed mixture No. 4.
1 sack Grass Seed mixture No. 5.
1 sack Grass Seed mixture No. 6.
1 sack Grass Seed mixture No. 7.
1 sack Grass Seed mixture No. 8.
1 sack Grass Seed mixture No. 9.
1 sack Grass Seed mixture No. 10.

TWELFTH DISTRICT.

To Colonel John A. Robinson.

*See letter of Col. Robinson under twelfth district wheat.

Destroyed by Freshets.

1 bushel Lucerne.
1 bushel German Clover.
1 bushel Sapling.
1 bushel Red Clover.
1 bushel Alsike.

No. Grass Seed mixtures from 1 to 10, inclusive. 1 sack each.

TENTH DISTRICT.

To T. J. Farnsworth.

Mostly Destroyed by Freshets.

1 bushel Lucerne.
1 bushel German Clover.
1 bushel Sapling Clover.
1 bushel Red Clover.
1 bushel Alsike.

Grass Seed mixtures 1 to 10 inclusive. 1 sack each.

The Grass Seed mixtures consisted of the following:

No. 1. For light soil. For pasture.
Red Top.
Orchard.
Perrennial Rye Grass.
Red and White Clover.

No. 2. For good, medium soil. Pasture.

Orchard.
Perrennial Rye Grass.
White Clover.
Kentucky Blue Grass.
Tall Meadow Oat.
Red Clover.

No. 3. For strong, deep loam. Pasture.

Red Clover.
Meadow Fescue.
White Clover.
Kentucky Blue Grass.
Red Top.
Orchard.

No. 4. For moist bottom land. For pasture.
Italian Rye Grass.
Red Top.
Meadow Fescue.
Timothy.
Alsike.
White Clover.

No. 5. For wet bottom land. Pasture.
Red Top.
Meadow Fescue.
White Clover.
Italian Rye Grass.

No. 6. For light soils. Meadows.
Orchard.
Perrennial Rye.
Tall Meadow Oats Grass.
Red Clover.

No. 7. For good medium soils. Meadow.
Tall Meadow Oat.
Kentucky Blue Grass.
Perrennial Rye.
Orchard Grass.
Red Clover.

No. 8. For strong deep loam. Meadow.
Kentucky Blue.
Tall Meadow Oat Grass.
Red Clover.

No. 9. For moist bottom lands. Meadow.
Red Top.
Meadow Fescue.
Timothy.
Alsike.

No. 10. For wet bottom lands. Subject to overflow. Meadow.
Red Top.
Meadow Fescue.

MISCELLANEOUS.

Variety of oats sown "Hargett's White."

Sowed 2 bushels per acre on a light, clay soil, fertilized at the rate of 150 pounds per acre with South Carolina bone. Oats was sown on a plat of land in a field sown to our common oats and re-

ceived the same cultivation. Crop made a vigorous growth. Ripened July 20th, ten days earlier than our common oats. Yield at the rate of 40 bushels per acres, while common oats yielded only 20 bushels per acre. Seed sown was of good quality, and I think the "Harfett Winter Oats is adapted to our soil and climate, and I can recommend this variety to our farmers. Will sow this variety another season.

Variety of oats sown, "Early Piasa Queen."

Was planted May 18, 1889, on a light sandy, loam soil, fertilized at the rate of 200 pounds per acre, with fertilizer received at the West Virginia Experiment Station. Seed did not germinate well. Plants made a sickly growth and did not mature until late in September. I would not recommend this variety on a sandy soil.

Variety of oats sown, "Early Orange."

Sown May 18, 1889, on clay soil, and fertilized with South Carolina bone at the rate of 150 pounds per acre.

Crop made a vigorous growth and ripened about September 1, 1889. Yield 80 gallons per acre. Ground was ploughed, harrowed, crossed two feet, and was cultivated three times during the growing season. I can recommend the Early Orange as suited to our soil and climate.

L. Shomaker.
Dellslow, Monongalia County, W. Va.

Corn.

Variety tested, "White Pearl."

Time of sowing, May 17th, on black, loose loam."

It did not mature right. Corn was soft, but I will not condemn it until I hear from others.

Oats.

Variety tested, "American."

Sowed May 8th. Crop grew finely; looked well, but unfortunately I sowed crop too near the house and it was destroyed by chickens until it was not worth saving. Crop was sown on black loam.

Planted some potatoes on ground prepared by using phosphate, but I do not think they were any better than some I planted without. I sowed the rest of the phosphate on wheat, and can not say now what the outcome will be. I have experimented a little with stable manure. The best results that I have is by harrowing manure in with either wheat or oats.

I did not plant the cane seed. I gave about half of it to my neighbors, and hope that their experience has been better than mine.

Respectfully, yours,

C. Holland,
Dellslow, Monongalia County, W. Va.

The phosphate received by me did not appear to be adapted to the soil to which I applied it. I applied it on oats in alternate strips with the South Carolina bone, with bad results. The bone on my land is far superior. I also tried it on corn, also upon potatoes with the same results; the South Carolina bone being superior on all crops. The land was clay soil, with tight sub-soil. I can not recommend the phosphate.

Yours respectfully,

L. SHOMAKER,

Dellslow, Monongalia Co.

CONCLUSION.

In conclusion I may say that we have received reports from only about 15½ per cent. of the samples of wheat sent out. We have one report from experiments with small fruits, berries, etc.

The work of the Station was done with as much care as was possible under the circumstances, and we are quite positive that most of the seed wheat, fruit trees and garden seed reached their destination, as freight bills have been received by us from, and paid for, the parties receiving the goods. Almost all of the farmers who received these articles are personally unknown to the Director. They were selected by the members of the Board of Regents as being among the farmers in their districts most likely to carry out the work contemplated.

Much has been said in the agricultural papers of the country of the impractical character of the experiments conducted at the Stations over the country, and it was hoped that we would have some results in this costly experiment which would justify the claims so loudly set forth, that the work done at Experiment Stations should be entrusted to those popularly known as practical farmers. At an expense of about $2,600, the experiments so loudly called for by writers in agricultural papers have been carried out in this State with results that are anything but encouraging, the farmers failing to respond.

In looking over the reports, we find but one from 708 experiments in wheat in which any attempt was made to carry out instructions. We have failed to receive any report from 85 per cent of the experiments and very few of those making reports claim to have any more than approximations. In the most of cases, the land and crops were estimated, not measured. It generally happens that there is no unanimity in results reported upon the same varieties, so that our conclusion is that no reliance whatever can be placed upon experimental work entrusted to persons unfamiliar with scientific methods and not provided with facilities for measuring their crops and lands.

It is evident that the attention to details necessary to make an experiment successful can not be bestowed upon it by the average farmer whose time is taken up with questions of more immediate and vital interest to him, and it is hoped that our experience will

be of the greatest possible value in this direction not only to this State, but to the stations located in other States. Few boards of control or boards of regents would have had the nerve to attack the problem upon the scale that our board has, and its experience if profited by throughout the country, is certainly well worth the money that has been expended in the effort. The attempt has been honestly made and faithfully carried out. It was intended as an answer to what appeared to be a popular demand that experimental work should be widely distributed over the State, and should be entrusted to "practical farmers" rather than to scientific men carefully trained in the methods of experimentation. Our board, after careful consideration of the subject and counsel with the Department of Agriculture, has deemed it wise to discontinue the effort to carry on experimental work of the character reported in this bulletin, and it has determed to abandon it.

Parties wishing seed wheat, fruit trees, etc., should therefore not expect to secure them from the station, as we have none for distribution, and they are respectfully referred to the dealers in these articles.

John A. Myers,
Director.

Bulletin No. 8

OF THE

WEST VIRGINIA

Agricultural Experiment Station

AT

MORGANTOWN, W. VA.

JUNE, 1890.

§

SUMMARY OF METEOROLOGICAL OBSERVATIONS, AND REPORTS OF CORRESPONDENTS ON CONDITIONS OF AGRICULTURE, ETC., IN THE STATE.

JOHN A. MYERS.

§

The Director does not hold himself responsible for the individual opinions of the various correspondents. It is hoped to extend the list of correspondents, so that the station and the public may be informed promptly concerning the prevailing conditions of the weather, crops and stock, in every part of the State.

§

CHARLESTON:
MOSES W. DONNALLY, PUBLIC PRINTER.
1890.

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H. R. BALDWIN, Jr.,	Chemist.
C. F. MILLSPAUGH, M. D.,	Botanist.
S. V. MYERS,	Stenographer.

REPORT OF W. A. MORGAN.

SHEPHERDSTOWN, JEFERSON CO., W. VA.

For month of April, 1890.

Weather more favorable and pleasant than usual, with a heavier average of rainfall. Not cold. Very little snow. The present condition of wheat and grass crops are considerably in advance of the season, and they are looking well all over the county. The present outlook indicates an abundant harvest. Oats are doing well. No barley or buckwheat as a crop sown. Peaches quoted as an entire failure. Apples and cherries look promising. Our stock have come out of the winter in a healthy and vigorous condition, there having been an abundance of provender. Market only moderate. Many hogs were lost during the latter part of the summer of 1889 by disease. Poultry flourishing. Market good. An extensive creamery, pulp mills, manufacture of lime, marble industry, cut stone for building, and bark mills, are the new enterprises of our county.

Wheat, corn and hay form the principal farming industry of of this section. Wheat and corn very remunerative. Hay paying better. Fruit raising, trucking pay well.

The mild and favorable winter and spring have given vegetation an early start, but the agricultural prospects are much depressed by unremunerative prices.

REPORT OF S. R. HANNEN.

GLEN EATON, MARSHALL, CO., W. VA.,

For the month of April, 1890.

Weather rather rainy, particularly during the last week. A little snow fell in the first half of the month.

Corn not planted. Wheat good, about 95 per cent. Oats rather small, average coming up fairly well. Grass good. No barley or buckwheat. Fruit prospect about an average.

Condition of live stock fairly good, with the exception of sheep. Too much rain for them to winter well, and there are not so many kept now as there were prior to 1883. No diseases as far as I have heard. Fair market for all except cattle, which

are low and slow sale. No new enterprise being developed, but a blast furnace at Benwood, and the proposed machine shops of the B. & O. Railroad about to be located at the same place.

The principal industries are raising wheat, hay, corn, oats, potatoes, some millet, and market gardening in the northern part of the county, cheese making and crermaries.

This has been a wool growing county, but fine wool is not paying as well as it formerly did.

Mutton sheep would pay well if introduced, I think.

REPORT OF EUGENE BAKER.

LEETOWN, JEFFERSON CO., W. VA.

For the month of April, 1890.

More rain than usual. Temperature variable. Some very warm days.

Corn average 9 bbls. per acre. The wheat very fine. Corn not yet planted.

Grass excellent. All crops will reach the standard. Wheat will average from 20 to 25 bushels. Peaches all dead.

Cherries badly injured. Grapes, apples, pears and berries O. K.

All kinds of live stock in good condition. Lambs early and large, sell for $3.75. No disease at present. There seems to be little demand for stock, especially horses. Creameries in county have created a small demand for cows.

Shannondale Springs, for thirty years idle, are being rebuilt and will be open to visitors this season. Two planing mills and sash factories; new wheat elevator and rock quarry, stone crushing mill, are now among the latest enterprises of the county.

The principal farming industries are in raising wheat, corn and grass.

Creamery not well developed. Cattle breeding and hog raising profitable.

The spirit of improvement seems slow to move our people, but it is at last beginning to move.

REPORT OF J. P. HALE.

CHARLESTON, KANAWHA CO., W. VA.

For the month of April, 1890.

Weather very cool. An unusual amount of rain. Do not know how much in inches.

Corn not planted. Oats looking well. Wheat looking well. No barley or buck-wheat raised here. Grass very good.

Owing to mild winter live stock is in good condition; better than average for the season. No disease attacking them.

Market fully up to the average.

No new enterprises being developed in our county.

Corn, wheat, oats and grass are the principal farming industries.

I think the cultivation of tobacco might be found profitable here.

REPORT OF S. A. HOUSTON.

PICKAWAY, MONROE CO., W. VA.

For the month of April, 1890.

Weather very bad. Much rain and a little snow.

Wheat below average; injured by late freeze. Oats just up. Meadows not promising. Pasture grass at this time good.

No peaches. Will be, I hope, one-half crop apples and cherries.

Condition of live stock good. No disease prevailing. Market poor. No money in stock raising of any kind, except sheep.

Creamery at Pickaway run one year with reasonable success.

The principal industries are raising stock, cattle, sheep, etc.

REPORT OF A. W. WESTFALL,

AUBURN, RITCHIE CO., W. VA.

For the month of April, 1890.

Plenty of rain during the month, but very little snow. Only three snow-squalls.

No corn growing yet. Wheat in good condition. Oats good. No barley raised in this or adjoining conties. Grass extra good. No buck-wheat growing. Peaches not one-fourth crop. Apples about three-fourths. Plums and cherries about the same average as apples.

Condition of stock good, especially horses and sheep. Cattle, swine, and poultry fairly good. No contagious diseases among them.

Market good for horses, sheep, swine and poultry. Cattle market not so good.

The principal industries are raising corn, wheat, oats, potatoes, &c.; also stock raising. Everything in a prosperous condition.

Farmers are realizing good prices for all products.

REPORT OF CAPT. LEE H. MOLER.

MOLERS, JEFFERSON CO., W. VA.

For the month of April, 1800.

It has rained two days out of three during the past month.

Corn not planted. Wheat flourshing. Oats seeded, not up yet. Barley very little sown, but in good condition. Buckwheat, not the season. Grass abundant. Clover not hurt by the freeze.

Fruit killed by frosts, except apples. Cattle in better condition than for years. Horses good. Sheep in excellent shape. Swine thriving, all owing to our mild winter. Poultry, a pet hobby just here. The sale of eggs and chickens could be made to exceed the corn crop of 1889 at 30 cts. per bushel; 5½ miles rail road developing line above iron ore beds. Bark mill, large Hotel at Harper's Ferry for summer boarders, etc.

Our industries are varied; corn, wheat and hay with the feeding of cattle engage our attention. Spring lambs bring remunerative prices. We claim to excell in almost everything that a good soil will bring forth. There is none other like our Jefferson county.

REPORT OF WM. HAYNES.

STOCKYARD, SUMMERS CO., W. VA.

For the month of April, 1890.

The weather has been very cool, wet and gloomy. Not a very heavy rainfall.

Very little corn planted in this section in April. The wet weather prevented the preparation of corn land and is the same with oats.

The wheat although killed down by the freeze of March, has grown again and is now looking well. Oats late and looking poorly. Grass doing well. Fruit of every kind in this region killed.

All kinds of stock are doing fairly well. No complaint of diseases among them.

Market for horses, cattle and sheep is improving.

We have in our county two strong companies opening quarries of brown stone. They employ quite a number of hands.

All grain crops are profitably grown in this county as well as the grass.

Live stock is raised. This is mainly a mountainous county. Quite an amount of lumbering is done.

REPORT OF W. G. AND M. D. RILEY.

ELK CITY, BARBOUR CO., W. VA.

For the month of April, 1890.

First of the month very wet; large rainfall and a little snow. The last week, weather good.

Wheat looks fine. Will average 95 per cent., compared with other years. Grass is backward, but there is a fine sod.

Fruit was hurt by the freeze in March. Peach trees nearly all killed.

The condition of live stock good. No diseases among them.

Market dull, except for sheep, for which it is good.

Our county does not raise enough to supply the demand for farm products. It is devoted to stock, horses, sheep and cattle.

Our people are much pleased with your efforts in their behalf. Hope you may be able to signal good for the farmer.

REPORT OF R. A. ALEXANDER.

CHARLESTOWN, JEFFERSON, CO., W. VA.

For the month of April, 1890.

Large rainfall.

The wheat more advanced and promising than for years.

Oats well advanced. Grass *very fine.*

Fruit not over three-fourths of a crop promised.

Cattle rather scarce and commanding a fair price. Horses in fine condition, selling at good prices. Sheep high.

Poultry scarce and high.

A bark-mill for grinding bark and extracting juice, established 1889, is the largest enterprise developed in our county.

Wheat and corn seem to be the only thing our farmers care to raise for market.

The season is well advanced and the farmers are doing well with their work.

REPORT OF GEO. T. EGBERT.

RAVEN'S EYE, FAYETTE CO., W. Va.

For the month of April, 1890.

A considerable amount of rain and several snow squalls.

About half of the oats sown.

Grass excellent.

Live stock of all kinds in better condition than usual, owing to the open winter.

Market, except for sheep, very dull.
Stock raising and general farming are the principal industries. Our county is well adapted to sheep husbandry.

REPORT OF W. C. KISEN.

FRANKLIN, PENDLETON CO., W. VA.

For the month of April, 1890.

Weather very rainy and a little snow.

Corn is just being planted.

Wheat is looking fine; promises more than an average crop. There is not a large acreage of oats sown. It looks well for the time of the year. No barley raised, and buckweat is not sown yet.

The condition of oattle moderately good. Some young ones have died from what we term "scowers." Horses in good condition. Market low. Sheep in good condition. Market good. Swine are looking well, but they are scarce. Cholera among poultry in some parts of county.

No new enterprise is being developed.

Stock raising is the principal industry. Corn and wheat are raised in considerable quantities.

REPORT OF J. W. CARDER.

PLEASANT DALE, HAMPSHIRE CO., W. VA.

For the month of April, 1890.

The weather has been cool and rainy. Quantity of rain above the average. No snow.

Condition of wheat good, considerably above the average for this month.

Grass doing finely. Very little corn planted as yet. Barley, none raised here. Prospects for fruit very unfavorable.

Condition of stock good No disease prevalent. Market for sheep and swine brisk. Horses medium. Cattle very dull.

No new enterprise being developed.

Producing wheat, rye, corn, oats and buck-wheat, are the principal farming industries. Stock is raised.

REPORT OF ADAM FISHER.

MOOREFIELD, HARDY CO., W. VA.

For the month of April, 1890.

The weather has been very wet and cool. No snow. I can not give quantity of rain and snow, as I have no rain guage.

Prospect for corn not flattering. Wheat and oats very promising. No barley. Pasture and meadows look extra well.

Condition of stock good, owing to the mild winter. Very little attention paid to poultry, too far from railroad.

Market has an upward tendency for stock generally.

Tan-bark and timber are the latest and most actively pursued enterprises in this county.

The principal farming industries are cultivating corn, wheat and grass in the valley. Oats and buck-wheat on the hills.

Moorefield, our county seat, is twenty-seven miles from a railroad and has a population of about 600.

REPORT OF M. S. BRYTE.

BRUCETON MILLS, PRESTON CO., W. VA.

For the month of April, 1890.

Weather has been very rainy during entire month. A little snow first part of April.

Wheat and grass in good condition. Prospect very good. The rainy weather will interfere with the sowing of oats. Fruits of all kinds badly injured. There will be some cherries and apples. It is feared that the peach trees have been killed in various localities.

Owing to the abundance of feed and the open winter stock of all kinds are in good condition. No diseases reported among them. Farmers complain of the ravage of cholera, especially among chickens.

Market fairly good, with prices ranging low.

A creamery at Terry Alta, and perhaps other points in the county, are the latest enterprises. The principal industries are in raising wheat, corn, rye, buckwheat, oats, grass, sorghum and potatoes. Fruits of all kinds, poultry, butter and eggs are produced.

REPORT OF W. G. AND M. D. RILEY.

ELK CITY, BARBOUR CO., W. VA.

For the month of May, 1890.

Weather cold and wet. Large amount of rain.

Wheat looks fine (95 per ct.). Meadows fine (100 per ct.). Sod was never better. Not many apples and not much small fruit.

Condition of live stock fine. Market horses dull; cattle same; sheep good. A number of the best cattle in the county have been engaged at $3\frac{1}{4}$ to 4 cts. per pound, to be delivered in August and September.

Wheat, corn, oats and stock raising are the principal industries.

REPORT OF S. A. HOUSTON.

PICKAWAY, MONROE CO., W. VA.

For the month of May, 1890.

Considerable rain, but no snow. Corn fair. Wheat below average. Oats fair. No barley sown. No buckwheat sown. Grass good.

Condition of live stock good. No disease. Market rather on upward tendency.

New enterprises, one creamery.

Stock raising is the principal industry. Too far from market for anything else.

We need above all things a reduction of the tariff, and free coinage of silver.

REPORT OF W. C. KISEN.

FRANKLIN, PENDLETON, CO., W. VA.

For the month of May, 1890,

An unusual quantity of rain. Weather warm.

Corn is beginning to look well. The prospect for wheat has not changed since last month. No barley.

Oats are looking well and promise a fine crop. Buckwheat not planted yet.

Condition of live stock good. No diseases. Market poor, with the exception of sheep, which are bringing fair prices.

Stock raising is the principal industry, although there is considerable wheat and corn raised.

With railroad facilicies, dairying would be profitable.

REPORT OF J. W. CARTER.

PLEASANT DALE, HAMPSHIRE CO., W. VA.

For the month of May, 1890.

Very wet and rather cool.

Corn a good acreage planted. Wheat above the average. Oats doing nicely. Grass good, prospects for a heavy crop.

No peaches; apples, prospect poor for half crop. Cherries very few.

Condition of cattle good. Market flat. Horses, condition good, local demand good for "No. 1" work horses.

Sheep market very active, quantity limited. Swine scarce, market good.

Poultry—too much wet weather, causing "*gapes*" in young; some cholera reported.

REPORT OF CAPT. LEE H. MOLER.

MOLER'S, JEFFERSON CO., W. VA.

For the month of May, 1890.

Rainy, only nine (9) clear days in the month.

Wheat "barring accidents" will make a good yield. Nights too cool for corn. Oats slightly rusted. Grass abundant.

Fruit in a manner killed.

Condition of live stock fine, owing to rank growth of blue grass No diseases as yet; prices are off.

New enterprises, are 5½ miles railroad, with limestone quarries. also connection to paying ore deposits.

Sheep and lambs, with the product of the hen houses, pay better than all other industries.

Jefferson county is really the garden spot of the world. Would like to know from whence the army-worm cometh and what is his paternity.

REPORT OF GEO. T. EGBERT.

RAVENS EYE, FAYETTE CO., W. VA.

For the month of May, 1890.

We have had a great quantity of rain.

The farmers are just finishing their corn planting, oats not as good as usual. Some late grass excellent. One fourth crop of apples would be a large estimate. Cherries good. Peach trees all killed.

Condition of live stock exceptionally good and free from disease.

Market, except for sheep, very dull, a few of the later changing hands at good prices.

REPORT OF ADAM FISHER.

MOOREFIELD, HARDY CO., W. VA.

For the month of May, 1890.

Exceedingly wet, more rain than in April.

Corn getting through. Wheat beginning to rust. Oats damaged too, by wet weather. No barley or buckheat. Grass more abundant than ever before. No fruit, average uncertain.

Condition of live stock good, no disease among them. Not much attention paid to poultry. Markets generally improving

Some prospecting for ore is a new enterprise in our county.

Corn and wheat, with stock raising are the principal industries.

Horse breeding on the increase.

If the rains continue much longer grain farming will be a failure.

REPORT OF J. P. HALE.

CHARLESTON, KANAWHA CO., W. VA.

For the month of May, 1890.

Cool for the season. A great deal of rain. No snow.

Corn just planted. Very late owing to wet weather. Wheat not looking well. Will not be over two-thirds of a crop. Oats not very promising. No barley. No buckwheat.

Grass looking very fine.

Condition of stock fairly good. Some diseases among cattle attributed to the mild winter, followed by the very wet and cold spring.

Market for stock good.

A furniture factory is the latest enterprise developed in our county. Some saw-mill extensions in the county also.

Corn, wheat, oats and grass are the principal farming industries.

Fruit culture is being extended and it is believed there is good promise in it.

The general health is good, as usual.

REPORT OF R. A. ALEXANDER.

CHARLESTOWN, JEFFERSON CO., W. VA.

For the month of May, 1890.

We have had excessive amount of rain during the month.

Corn and oats promise well. Grass very fine. Wheat thick on ground, but the heads are not as long and full as they might be. The fruit crop will not be over one-fourth of what it usually is.

Stock in fine condition. No disease. Cattle looking up. Horses dull. Sheep and lambs high. Swine good prices.

We have started an improvement company here and Harper's Ferry, and our people are alive and fully up to the times, and the movement toward building, etc.

The principal farming industries in our county are, wheat, corn, oats and cattle.

Our farmers by good management have been working out of debt, and are in good shape.

REPORT OF A. W. WESTFALL.

AUBURN, RITCHIE CO.. W. VA.

For the month of May, 1890.

No snow. Plenty of rain, averaging at least three days during each week. Corn not very good on account of too much rain.

Wheat very good. Grass in large quantities, but not of good quality.

Peaches entire failure. Apples and various other fruits about a three-fourths crop.

Condition of stock very good, especially sheep. Market for horeses and sheep remarkably good, while cattle, swine and poultry very indifferent. No disease prevalent.

No new enterprise being developed. Stock and grain raising is the principal farming industry. Lumber business is carried on extensively. General business outlook good.

REPORT OF WM. HAYNES.

STOCK YARDS, SUMMERS CO., W. VA.

For month of May, 1890.

Frequent rains have fallen, but with small amount of rainfall. Days warm, nights a little cool. The weather has been good for corn, which is doing well.

Wheat is doing fairly well. Late wheat is rather light. Oats very late. Few fields look well. Grass very fine. No fruit. Live stock are doing well, no diseases. Market poor.

No new enterprises except those mentioned in last report. Stock raising is the leading industry. Grass and grain crops grow well. A large amount of staves and lumber has been cut in this county.

REPORT OF EUGENE BAKER.

LEETOWN, JEFFERSON CO., W. VA.

For the month of May, 1890.

Very rainy. Terrific hail and wind storm on May 3rd., swept every thing in its course.

Corn delayed by wet weather. Wheat very fine. Oats good. Grass excellent. No peaches, few charries and pears. No apricots. Plenty of berries, from present outlook, I think. Wheat will average 25 bushels per arce in this county, except in the track of the storm of May 3rd., where not a grain will be made.

Live stock in good condition. No diseases. Market low.

Lambs from \$3.50 to \$4.25, according to size. Wool 25 to 27 cents a pound.

Hogs low, also cattle. No market for horses.

Charslestown is on a big boom. Expect to have many new enterprises soon. Will report them in my next.

The principal farming industries are wheat, corn and grass.

The storm spoken of, passed over the north end of this county, taking in Middleway and Summit Point. Wheat, corn, grass, trees, buildings, &c., destroyed to the amount of \$10,000. Wind travelled at rate of sixty miles an hour.

REPORT OF S. R. HANEN.

GLEN EASTON, MARSHALL CO., W. VA.

For the month of May, 1890.

No snow, but an unprecedented amount of rain.

Corn not all planted on account of rain. Wheat promises a full crop, or say 98 per cent at least.

Oats a full crop. No barley raised. No Buckwheat. Grass good.

Fruit will average half crop.

Condition of live stock good. No diseases, as far as I have been able to ascertain.

Sheep, fair condition, but they did not winter well on account of excessive rain during winter months.

Several wells have been bored for oil. No reports from them yet.

Grass, wheat, corn, oats, and potatoes with market gardening are the principal farming industries here.

A woolen mill would pay.

REPORT OF W. A. MORGAN.

SHEPHERDSTOWN, JEFFERSON CO., W. VA.

For the month of May, 1890.

An unusual amount of rainfall, beginning the 15th and continuing to the 26th. No snow.

Corn is coming up well, looks healthy and vigorous.

Wheat crop generally very promising and heading well, an unusually large growth. Oats growing rapidly and looking well. Grass crop very luxuriant and promising, a heavy yield of clover timothy and orchard grass.

Horses and cattle in excellent condition, also sheep and swine healthy and thrifty. Poultry interest much looked after and largely engaged in.

No disease among live stock at present. Market for cattle improving. Sheep and poultry in demand.

Paper mills, bark mills, flouring mills, lime kilns, building stone cutting, a McAdamized road being constructed, the finest in the county. Fruit tree nurseries, etc., are the new enterprises being developed in our county.

Wheat, corn, oats, hay, potatoes, poultry, fruit and stock are the principal industries of our county.

Our county is now looking beautiful with its fine fields of luxuriant wheat and blooming meadows, &c.

REPORT OF WM. HAYNES.

STOCK YARDS, SUMMERS CO., W. VA.

For the month of June, 1890.

The weather has been very dry and hot during this month. Crops are suffering for rain.

Wheat is regarded as only a half crop. Corn needs rain; looks badly. Oats and grass drying up. Hay crop tolerably good. No fruit.

Condition of live stock very good. No new enterpises being developed. Stock raising is the principal farming industry. Any grain or grass grows well in this locality.

REPORT OF R. A. ALEXANDER.

CHARLESTOWN, JEFFERSON CO., W. VA.

For the month of June, 1890.

There has been considerable rain fall this month.

Good prospect for corn. Wheat some little scab, but on the whole good. We had a hail-storm that destroyed in the Kabletown and Middleway District at least 1,000 acres entirely, and damaged badly 1,500. Very little oats. No barley or buckwheat. Grass fine. Very little fruit.

Live stock in *fine condition* with a fair market.

We have formed a Land and Improvement Company here, with good prospects.

Iron ore and lime-stone are being developed in our county.

Wheat and corn, and now more attention to grass, (hay). Sheep have been most profitable and the number will be largely increased this year. These are the principal farming industries.

If we had escaped hail this year, aside from fruit, (1890) would have been our most prosperous year in the last ten.

REPORT OF ADAM FISHER.

MOOREFIELD, HARDY CO., W. VA.

For the month of June, 1890.

The rains continue, but are not now so frequent.

Corn looks promising. Wheat improved. Oats rather indifferent. No barley. No buckwheat. Grass unusually abundant.

Cattle, horses, sheep and swine all in good condition. No attention paid to poultry. No diseases among them. Market fluctuating.

No new enterprises being developed. Stock raising and grain

of the common kinds, and grass, are the principal farming industries.

Cattle feeding has been the leading business of the farmer. Horse breeding has increased of late.

REPORT OF W. C. KISEN.

FRANKLIN, PENDLETON CO., W. VA.

For the month of June, 1890.

There has been large quantities of rain this month.

Corn short for time of year. Wheat is affected with rust and scab, will fall below average. Oats do not look well all over the county. Buckwheat just sowed. Grass good.

Live stock in good condition. No diseases. Market dull for all but sheep.

No new enterprises being developed. Stock raising, wheat and corn are the principal farming industries.

Dairying might be made profitable, and I have no doubt would, if we had a railroad.

REPORT OF J. W. CARTER.

PLEASANT DALE, HAMPSHIRE CO., W. VA.

For the month of June, 1890.

Weather warm and wet. Have had about double the quantity of rain we generally have in this month.

To take 100 as an average corn will be 100, wheat 125, oats 100, grass 125 and fruit crop about 10, buckwheat not yet sown.

Live stock in good condition Market for cattle very flat. Horses steady but not brisk. Sheep high, very active. Swine scarce and prices strong, not many changing hands. Poultry market good, the crop of young supposed to be light.

Producing wheat, rye, oats and corn are the principal farming industries and also stock raising.

REPORT OF EUGENE BAKER.

LEETOWN, JEFFERSON, CO., W. VA.

For the month of June, 1890.

Weather warm, not much rain, but sufficient for crops. Hail and wind upon two occasions.

Corn doing well, rather late. Oats very poor. Wheat good, some scab and a little rust. Oats will be nearly all cut by July

1st, some complain of blight. Crop will average 15 bushels. Grass fine, very little cut up to this time.

Horses and sheep in good order, Texas Fly very bad on cattle, cholera appearing in swine. Market low and small demand. Butter from 6 to 10 cts per. pound. Milk 30 cts. cwt. Boom at Charlestown, expect to open mines, factories, railroads, &c.

The "Farmers Alliance" is making good headway in our county. Its effects are plainly visible. Brought binder twine from 18 to 14 cts. per pound, &c.

REPORT OF W. A. MORGAN.

SHEPHERDSTOWN, JEFFERSON CO., W. VA.

For the month of June, 1890.

Early part of month very wet. May 30, a terrible and very destructive wind and hail-storm through the county a track of about two miles wide, entirely destroying all crops and gardens and demolishing many buildings, trees, etc.

Corn growing finely. Wheat now being harvested, generally a very good crop; well headed and filled and standing erect. Oats growing well. A very heavy crop of clover and timothy. Little barley raised and no buckwheat. From present appearances wheat will average 15 bushels per acre, and grass from one and a half to one and three-fourths tons per acre.

Live stock in good condition. No diseases reported. Poultry plentiful and well grown. Market for cattle good and improving for beef and mutton. Sheep and lambs scarce and in good demand at good prices.

Wheat, corn, oats and potatoes are the principal industries; and fruit, trucking, dairying and poultry could be made profitable. Our entire county with the exception of the storm swept district present a beautiful and luxuriant appearance.

REPORT OF LEE H. MOLER.

MOLER'S, JEFFERSON, CO., W. VA.

For the month of June, 1890.

Weather has been good. Not much of a rain fall.

Corn, good stand, and growing finely. Wheat damaged by scab. Oats not one-half crop; rusted badly. Grass abundant. Fruit crop a failure, except in some small sections.

Cattle in very fine order. Horses good; large number of colts this spring. Sheep are in demand. Swine so far not attacked by cholera. Poultry in the immediate section is more valuable than corn. Some few cases of cholera. No sales made at this period.

Land companies have been organized in Charlestown with quite a boom.

The principal farming industries are wheat, corn and hay, with an increase in sheep husbandry each year.

Began harvesting to-day, the 19th. Wheat stands well.

REPORT OF J. P. HALE.

CHARLESTON, KANAWHA CO., W. VA.

For the month of June, 1890.

The average temperature of the month has been unusually high. More rain than usual for June.

Corn. Fair, wheat light. Oates light. No Barley. Grass good. Fruit almost a failure.

Some "*foot evil*" among cattle .Horses, sheep and swine in good condition. Poultry all right.

Street railway being constructed in Charleston. Bridge across Kanawha river under contract.

The principal farming industries are wheat, corn and oats.

REPORT OF GEO. T. EGBERT.

RAVENS EYE, FAYETTE CO., W. VA.

For the month of June, 1890.

We have had frequent showers this month.

Corn promising. Prospect for an oats crop very poor. Grass very fine.

Fruit almost a total failure.

Live stock in good condition. Market very dull, except for sheep, and they are in demand.

No new enterprises are being developed in our county.

REPORT OF W. G. AND M. D. RILEY.

ELK CITY, BARBOUR CO., W. VA.

For the month June, 1890.

Weather warm and wet. Too much rain for farming purposes.

Corn looks well, has been too wet for clean cultivation, average about 95 per cent. Too wet for wheat, not filled well, 75 per cent. Oats look well, about 95 per cent. Grass fine, about 100 per cent. Very little fruit, 25 per cent.

The condition of live stock is good. No diseases among them. Cattle dull sale, horses bad, but sheep find a ready market. Boring for oil at Philippi is the only new enterprise being developed in our county. Stock raising is the principal farming industry.

The depreciation of land in the last ten years has been from 30 to 40 per cent But little is made by farmers generally.

REPORT OF A. W. WESTFALL.

AUBURN, RITCHIE CO., W. VA

For the month of May, 1890.

The weather has been rainy, averaging two days per week.

Corn very good. Wheat fair to medium. Oats looking very well. Grass better than it has been for years. Outlook for fruit not good. Stock in good condition. Market very good, especially sheep and poultry. No diseases attacking them. No new enterprises being developed. Raising stock and the various grains are the principal farming industries. Every thing in a prosperous condition.

METEOROLOGICAL OBSERVATIONS.

Summary of Observations taken at the West Virginia Agricultural Experiment Station at Morgantown, beginning October 10, 1888 and ending June 1, 1889.

BAROMETER, Reduced to Freezing Point for October November and December.	October.	November.	December.	January.	February.	March.	April.	May.	June.
Mean of morning observations	29.112	29.199	29.131	29.086	29.159	29.045	29.107	29.132	....
Mean of afternoon observations	29 061	29 141	29 090	29.060	29.169	29.026	.9 105	29.112	....
Mean of evening observations	29 073	29 165	29 102	29 081	29.180	29.032	29.126	291 16	.....
Mean of all obsersations	29 082	29.168	29.108	29.076	29. 169	29.034	29·113	29.120	....
Highest reading	29.365	29.535	29.496	29.450	29.675	29.450	29.500	29.400	....
Lowest reading	28 713	28.717	28.447	28.225	28.500	28.555	28.630	28.800	....
Range	.652	.818	1.049	1 225	1.175	.895	.870	.600	
THERMOMETER.									
Mean of morning observations	45 5	40.4	30 5	31 5	26.3	34.5	45.8	57.3	....
Mean of afternoon observations	57 7	51.9	40.4	40.8	34.5	48.6	59.6	70.6	....
Mean of evening observations	50.2	44 8	34 8	35 8	29 9	43.5	52.8	62.8	....
Mean of all observations	51.1	45.7	35.2	36.0	30.2	42.2	52.7	63.6	....
REGISTERING THERMOMETER.									
Maximum reading	76	76	69	60	55	69	84	90	....
Minimum reading	32	22	6	16	4	18	23	35	....
Mean of maximum readings	59.1	54.5	42 3	43 8	36.9	51.1	66 6	73 4	....
Mean of minimum readings	42.2	37.1	28	29 7	23·2	33.4	42 8	52 2	....
Range of mean reading	16.9	17.4	14.3	13 8	13.7	17.7	19.5	21.2	....
HYGROMETER.									
Mean relative humidity of morning observations	88	85	....	....	....	83.6	83.9	83.4	....
Mean relative humidity of afternoon observations	70	75	....	....	....	75.7	71.6	69.9	....
Mean relative humidity of evening observations	84	33	....	....	....	82.5	78.0	82.4	....
Mean relative humidity of all observations	80	81	....	....	....	80.6	77.8	78.6	....
CLOUDS.									
Mean cloudiness of morning observations	....	70	76.5	74.7	85.7	62.2	51.2	59.3	....
Mean cloudiness of afternoon observations	....	59	62.6	59.1	56.4	62.3	59.5	60.3	....
Mean cloudiness of evening observations	....	56.6	63	58 1	56.4	66.5	57.2	50.7	....
Mean cloudiness of all observations	....	61.9	67.4	63.9	66.2	63.7	55.9	56.8	....
ANEMOMETER.									
Total number of miles traveled	....	....	....	4642	5391	3820	4435	3166	2780
Average number of miles traveled daily	....	....	....	149 8	192.5	123.3	147.8	102.1	92.7
Average velocity per hour	....	....	....	6.24	8.02	5.14	6 16	4.24	3.86
Prevailing direction	S. W	S. W.	S. W.	S. W.	S. W.	S. W.	S. W.	S. W	S. W.
PRECIPITATION.									
Number of days on which rain fell	14	15	8	13	6	11	12	13	....
Number of days on which snow fell	....	4	10	5	10	10	1		
Total precipitation in inches	....	3 91	1.21	2.82	2.88	3.31	4.82	5.36	....
WEATHER.									
Number of observations when the sky was wholly clear	....	....	....	21	15	13	21	19	....
Number of observations when the sky was clear	....	....	....	15	2	15	10	9	....
Number of observations when the sky was medium	....	....	....	1	5	9	5	17	....
Number of observations when the sky was cloudy	....	....	....	3	10	4	5	1	....
Number of observations when the sky was overcast	....	....	....	7	6	8	11	19	....
Number of observations when the sky was covered	....	....	....	42	37	36	28	25	....

METEROLOGICAL OBSERVATIONS.

Summary of Observations taken at the West Virginia Agricultural Experiment Station, at Morgantown, beginning March 1, 1890, *and ending June* 30, 1890.

	February.	March.	April.	May.	June.
THERMOMETER.					
Mean of morning observations	33.0[illegible]	37.2	45.6	56.5	66 5
" " afternoon "	42 8	43.4	62.7	76	79.5
" " evening "	36.8	42 1	60.9	64.2	75 1
" " all "	37.5	39.09	55 9	65 06	74 2
" " maximum reading	43.2	47.01	66 1	39 1	79.2
" " minimum "	31 8	27.3	44.2	56.1	65 2
Range of mean	18.2	20.2	54 5	12.8	13.4
HYGROMETER.					
Mean relative humidity of morning observations	65.5	58 2	71 2	71 69	82.1
" " " afternoon "	69.04	55 3	63 5	69 9	75 1
" " " evening "	71	53 7	72 7	80.1	76 6
" " " all "	72	48.6	70 5	74 4	28.7
CLOUDS.					
Mean cloudiness of morning observations	52.7	75 5	58 1	56.9	52 5
" " afternoon "	59.9	79 1	40.3	53.2	51.5
" " evening "	44.09	72 2	48.1	37.5	32.5
" " all "	45.8	69.3	47 8	57 6	.43
PRECIPITATION.					
Number of days on which rain fell	9	12	12	21	14
" " " " " snow fell	....	....	....	....	......
Total precipitation in inches	3.275	3 65	2.12	7.38	5.28
WEATHER.					
Number of observations when the sky was wholly clear	31	15	38	24	22
" " " " " " " medium	12	12	11	26	27
" " " " " " " cloudy	17	....	1	2	13
" " " " " " " covered	....	63	37	40	23
" " " " " " " clear	1	3	3	1	4
" " " " " " " overcast	....	....	....	....	1
ANEMOMETER.					
Prevailing directions	[illegible]	S. W.	S. W. N. E.	S. W.	SW
Barometer reduced to freezing point for Febr[illegible] April, May and June					
Mean of morning observations	[illegible]	[illegible]	[illegible]	29.015	
" " afternoon "	29.[illegible]	[illegible]	[illegible]	28 841	
" " evening "	28 472	28.[illegible]	[illegible]	28 758	
" " all "	29.142	28.324	28.[illegible]	28.869	
Highest reading	29 343	29.909	29.946	29 250	
Lowest reading	28.616	28.114	28.415	28 103	
Range	.727	1 795	1 531	1.247	

BULLETIN NO. 9.

OF THE

WEST VIRGINIA

Agricultural Experiment Station

JULY, 1890.

—§—

I. Additional Reports upon Wheat Distributed in 1889.
II. Meteorological Report for July.
III. Reports of Correspondents upon Meteorology and Crops for July.

By John A. Myers, *Director*.

—§—

The director does not hold himself responsible for the opinions of Correspondents.

—§—

CHARLESTON:
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1890.

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ADDITIONAL REPORTS UPON WHEAT DISTRIBUTED IN THE FALL OF 1887.

Variety of wheat tested "Velvet Chaff."

Seed was not pure, it contained cockle.

Sowed 1½ bushels per acre September 8, 1889, on sandy loam clay soil, prepared by plowing, harrowing and rubbing until it was in fine condition, then drilled. Condition of soil at time of sowing was good. Land was in pasture in 1887. Soil is considered good for wheat. The weather following sowing was favorable for the growth of wheat, and stand secured in the fall was good. Think it would withstand frost and drought. Ripened about July 1. Yield 12 bushels per acre. Owing to the cold and wet spring, the crop was cut short one-fourth in my opinion. Think it might be a good wheat under more favorable conditions; but was not so good as some other varieties in this vicinity under same conditions.

E. J. Owings,
Holliday's Cove, W. Va.

Variety of wheat tested "Golden Amber."

Seed was mixed and had cockle in it.

Sowed 1½ bushels per acre on September 8, 1889, on sandy loam soil prepared by plowing, harrowing, drilling. Soil was in good condition at time of sowing. Land in 1887 was in pasture. Soil is considered good for wheat. Weather following was unfavorable for growth of wheat. Stand of wheat secured in the fall was good. Cold and wet weather retarded growth of wheat in the spring. Ripened 1st of July. Yield 15 bushels per acre. I think it a fair wheat, has a nice clear hard grain; but a short head well filled. Is a bearded wheat, which is against it. Think it better wheat than "Velvet Chaff." Did not yield a full crop owing to wet spring.

E. J. Owings,
Holliday's Cove, W. Va.

Variety of wheat tested, "Michigan Bronze."

Qaulity of seed was good; but contained some cockle.

Sowed 1½ bushels per acre September 8, 1889, on sandy loam clay soil, prepared by plowing, harrowing, rubbing or dragging with a plank drag, and drilled. Condition of soil at time of sowing was good. Land was in pasture in 1887. This soil is considered good for wheat. Weather following sowing was good for growth of wheat, and stand secured in the fall was good. Ripened July 5. Yield 18 bushels to the acre. It was the only wheat in the field that any one has asked for seed. Much like the "Pool," but bearded. I consider it the most valuable to the farmers of West Virginia of the three varieties tested.

E. J. Owings,
Holliday's Cove, W. Va.

METEROLOGICAL OBSERVATIONS FOR JULY, 1890.

West Virginia Agricultural Experiment Station, Morgantown, W. Va.

	PRESSURE Barometer and Thermometer.						Standard Thermometer.				Maximum and Minimum. Temperatnre.			Humidity Hygrometer.				Clouds Percentage of			Precipitation Rain & Snow.		Direction of Wind.		
	a m 7	am 7	p m 2	pm 2	p m 9	pm 9	a m 7	p m 2	p m 9	Av	a m 7	a m 7	Dif	a m 7	p m 2	p m 9	Av	a m 7	p m 2	p m 9	No Rn	Fall	a m 7	pm 2	p m 9
1	....	......	....	......	....	......	76	78	79	77 6	86	74	12	89	89	89	89.	100	80	100	3	.27	e	s e	s
2	....	......	....	......	....	......	77	85	76	79.3	83	74	9	89	72	79	80.	100	40	100	2	.25	n w	s w	s e
3	....	......	....	...	....	......	73	84	78	78.3	84	71	13	89	72	79	80.	100	75	100	2	.17	s e	n w	s w
4	....	84	28.550	86	28 516	.....	74	84	73	77.	82	71	11	72	76	70	72 6	75	25	100	1	.33	n w	s w	s w
5	28 641	68	28 632	74	28.631	77	63	75	68	69	84	61	23	77	71	78	75 3	00	00	00	......	....	n	n	s
6	28 602	75	28.5 4	81	28.623	80	61	81	76	72.6	74	62	12	77	95	79	83.6	00	25	00	......	....	n	n w	s
7	28.632	75	28 571	87	28 5 6	83	70	87	83	80.	82	60	22	78	72	80	76 6	50	00	00	......	....	s	s	s
8	28 597	80	28.478	91	28.400	90	75	91	86	84.	87	67	20					00	50	00	......	....	s w	s w	s w
9	28 490	84	28.418	85	28.646	82	80	86	72	79.3	91	75	16	80	64	70	71.3	50	50	00	....	....	n w	n	n
10	28.624	67	28 607	76	28 698	78	60	75	69	68.	85	64	21	77	63	50	63 3	00	00	00	......	....	n	n	s
11	28.705	68	28.532	79	28 631	80	60	80	71	70.3	79	57	22	77	71	79	73.6	00	00	00	.....	....	n	n w	n
12	28 652	70	28 532	82	28.586	75	61	80	77	72 6	75	57	18	77	71	71	71.	00	00	100	......	....	n w	s w	s w
13	28.512	78	28 508	81	28.491	86	70	77	75	74.	60	81	21	88	79	79	82.	100	100	00	....	....	s e	s e	s
14	28 493	84	28 488	85	28 593	85	70	85	82	79.	79	67	12	88	80	80	82.6	00	24	00	.....	......	s w	s w	s w
15	28 611	81	28 593	88	28 578	87	75	88	85	82.6	86	68	18	84	90	90	88	100	50	100		....	s e	s w	n
16	28 711	81	28 696	86	28 581	88	77	85	82	81.3	89	73	16	79	72	80	77.	100	50	00	......	....	s w	s w	n e
17	28 604	81	28.696	86	28 581	88	77	85	82	81 3	87	72	15	84	72	80	78.6	100	50	00	....	....	s w	s w	n e
18	28 604	81	28.455	88	28 467	88	77	88	85	83 3	87	72	15	84	90	....	87.	100	50	100	....	....	s w	s w	s w
19	28 641	67	28.596	78	28.699	77	61	78	69	69 3	82	57	25	77	71	69	73 3	00	50	00	......	....	n	n	n
20	28 616	70	28.715	77	28.730	74	57	76	66	66 3	78	55	23	66	63	78	69	100	25	50	......	....	n	n e	n
21	28.703	68	28.681	76	28.569	73	59	76	72	69	75	53	22	66	63	70	66 3	00	25	00	......	....	n e	n e	e
22	28.721	69	28 611	80	28 596	79	64	80	75	73.	75	66	9	78	57	63	66.	00	25	00	......	....	n e	s w	s e
23	28.620	70	28.596	74	28 504	75	67	80	70	72 3	80	64	16	88	88	88	88.	80	100	100	2	.17	s e	s	s e
24	28.410	71	28 421	75	28.409	77	69	74	74	72 3	74	65	9	88	79	70	79.	100	100	50	1	.75	s e	s w	s e
25	28 389	77	28.674	82	28.384	74	70	81	74	75	75	73	2	84	80	89	74.3	100	75	100	3	.66	s	s w	s
26	28 486	75	28 491	80	28.424	79	70	79	74	74.3	82	72	10	84	79	89	84.	100	75	00	1	.22	s w	n w	s w
27	28 624	75	28 598	79	28 509	80	66	81	75	74	78	63	15	78	72	79	76.3	00	50	00	......	....	s w	s w	s w
28	28.605	72	28 6 2	81	28.620	79	68	80	79	75 6	82	64	18	88	80	76	81.3	100	100	100	......	....	n	s e	n e
29	28 720	74	28 667	83	28.700	82	70	83	78	77.	81	66	15	88	64	89	80 3	50	50	00	......	....	s e	s w	s w
30	28 826	77	28 816	86	28.736	84	70	88	80	79 3	84	74	10	84	58	89	77.	00	25	25	.....	....	s w	s w	s w
31	28.597	77	28.488	88	28.487	87	74	90	83	82 3	86		16	79	....	....		00	25	50	......	....	s w	s w	s w
	28.609	75	28.582	82	28 570	80	69.03	81.93	76.42	75.79	Max. 91	Mim 53	Diff 38	81 8	74.6	77.9	77.9				15	In. 2 82			

REPORTS OF CORRESPONDENTS.

REPORT OF W. C. KISEN—FRANKLIN, PENDLETON CO.

For the Month of July, 1890.

Weather very hot and dry. Very little rain. Warmer weather than has been for years. Corn short. Wheat half crop, or about 9 bushels per acre. Oats light. Buckwheat not more than half crop. Grass heavy and hay well made, as the weather has been fine for haying. The Texas fly has made its appearance among the cattle and is very annoying. Cattle not doing well. Horses doing well, prices low. Sheep doing well, prices good. Swine well, but scarce. Poultry well. No new improvements.

W. C. KISEN.

REPORT OF ADAM FISHER—MOOREFIELD, HARDY CO.

For the Month of July, 1890.

Weather exceedingly hot and dry up to the 24th. On the 25th it rained, say half inch. Corn is injured by the drought, especially on the uplands. On the bottoms a prospect for two-thirds of a crop. Oats generally in the shock and light, meadows heavy and secured in good condition. Pastures parched. All kinds of stock in good condition. No disease among them. Market price low. New enterprise hoped for, but nothing in sight. Products, corn, wheat and grass. This month has been exceedingly hot, much of the time above 90.

ADAM FISHER.

REPORT OF W. A. MORGAN—SHEPHERDSTOWN, JEFFERSON CO.

For the Month of July, 1890.

Weather unusually dry with severe storms of thunder and lightning. More electricity than usual. Corn growing well. Wheat succeeds in making from 20 to 28 bushels per acre by those who have threshed. Oats a good crop. Grass an excellent yield. No buckwheat, and but very little barley raised in this county. Fruit almost a total failure. Condition of stock good and thrifty, no disease reported. Market generally good, with a good demand for beef cattle and sheep since last June. Products, wheat, corn, oats, potatoes, stock raising. Fruit raising more is profitable as the market for grain has been poor for several years. The general condition of farms good, with crops harvested and in good condition.

W. A. MORGAN.

REPORT OF WM. HAYNES—STOCK YARDS, W. VA., SUMMERS CO.

For Month of July, 1890.

Weather, severe; burning drought. Corn wilting for want of rain; very short. Wheat harvested in good order; crop short. Grass burned up for want of rain. Fruits none. Oats worthless. Condition of live stock, fair. Grass scarce; will check increase in weight. No disease attacking stock. The market seems to be advancing, and demand increasing. Nothing new, but tan bark, grain, grass, and stock growing.

WM. HAYNES.

REPORT OF J. P. HALE—CHARLESTON, W. VA., KANAWHA CO.

For Month of July, 1890.

Weather quite warm. Very little rain. Corn crop looks well, will be an average crop or over. Wheat not over half a crop. Oats a failure. Barley not raised. Buckwheat, none. Grass, good. Fruit almost a failure, killed by early frosts. Condition of live stock, fairly good. Nothing special to note relating to any of them. Market cattle real low. Horses and mules well up. Healthy condition generally. Nothing new of special importance. Industry same as before.

J. P. HALE.

REPORT OF J. W. CARTER—PLEASANT DALE, HAMPSHIRE CO.

For Month of July, 1890.

Weather mostly dry and very hot. Corn short and needing rain. Wheat is harvested and proves rather a surprise to our farmers. When they began to harvest they found the crop about three-fourths instead of one-fourth. Oats not filled, about one half crop. Hay crop good and mostly harvested in good condition. Condition good; no disease reported. Market for cattle very flat. Large horses in demand. Sheep active and high. Swine active. Poultry market good. Hope to report some new enterprise soon.

J. W. CARTER.

REPORT OF GEO. T. EGBERT—RAVEN'S EYE, FAYETTE CO.

For the Month of July, 1890.

Weather, frequent showers, in consequence of which harvest has been delayed. Hay crop good. Pasture getting short. Corn looking well. Oats almost a failure. Fruit crop in this section a complete failure. Live stock in good condition, but with the ex-

ception of sheep, there is no demand; the latter are scarce and high.

GEORGE T. EGBERT.

REPORT OF W. G. AND M. C. RILEY--ELK CITY, BARBOUR CO.

For Month of July, 1890.

Weather warm and dry; two or three very light showers. Corn looks well, but it must have rain soon or it won't amount to much. Wheat is thrashing out about half crop. Oats about half crop. Too dry for buckwheat. Hay very good. Pasture drying up. Condition of stock good. Market for horses and cattle dull. Sheep are good; no disease among them. Stock raising is our principal industry. We don't grow enough grain for home use. The farmers liked the instructions delivered by Mr. Johnson, at Phillipi, during the institute.

W. G. & M. C. RILEY.

REPORT OF S. R. HANEN—GLEN EASTON, MARSHALL CO.

For Month of July, 1890

Weather warm and dry. Fall of rain very limited. Wheat not filled, about 50 per cent. Corn suffering from drought, perhaps 75 per cent. Oats 75 per cent. Grass good, 100 per cent. Fruit almost an entire failure, not more than 20 per cent. Potatoes not good, about 45 per cent. Stock in good condition, some pinkeye reported in the northern end of the county. Some cholera among the poultry. Market good. The B. & O. Railroad is grading for large shops and round houses at Benwood.

S. R. HANEN.

REPORT OF SAMUEL A. HOUSTON—PICKAWAY, MONROE CO.

For the Month of July, 1890.

Weather very dry. One half crop of corn. Wheat 60 per cent. Grass 90 per cent. Fruit very little. All stock have done well —no disease. Market low. One creamery. Stock raising.

SAMUEL A. HOUSTON.

REPORT OF R. A. ALEXANDER—CHARLESTOWN, JEFFERSON CO.

For the Month of July, 1890.

Moderate rains. We will have a very fair crop of corn. The wheat turning out from the machines fairly well; quality good. Live stock in fine condition, with moderate prices. We are trying to extend our town by selling stock in a land company, and hope to

bring enterprises. Wheat, corn and cattle. Our farmers are going largely into sheep this year, finding them very profitable.

R. A. ALEXANDER.

REPORT OF A. W. WESTFALL—AUBURN, RITCHIE CO.

For Month of July, 1890.

Weather, very little rain, no snow. Same condition as last report, except fruit crop, which is almost an entire failure. Condition of stock good; ordinary market. New enterprises, none. Grain and stock raising. Every thing in very good condition.

A. W. WESTFALL.

BULLETIN NO. 10.

OF THE

WEST VIRGINIA

Agricultural Experiment Station.

AUGUST, 1890.

I. Meteorological Report for August.

II. Reports of Correspondents upon Meteorology and Crops for August.

By John A. Myers, *Director*.

The Director does not hold himself responsible for the opinions of Correspondents.

CHARLESTON:
Moses W. Donnally, Public Pninter.
1890.

BOARD OF REGENTS OF THE WEST VIRGINIA UNIVERSITY

District.	Name of Regent.	P. O. Address.
1.	J. B. SOMMERVILLE,	Wheeling.
2.	CLARENCE L. SMITH,	Fairmont.
3.	PEREGRIN HAYES,	Glenville.
4.	D. D. JOHNSON,	Long Reach.
5.	JOHN G. SCHILLING,	Spencer.
6.	EDWARD A. BENNETT,	Huntington.
7.	WIRT A. FRENCH,	Princeton.
8.	M. J. KESTER,	Union.
9.	D. C. GALLAHER,	Charleston.
10.	THOMAS J. FARNSWORTH,	Buckhannon.
11.	JOSEPH MORELAND,	Morgantown.
12.	JOHN A. ROBINSON,	Patterson's Depot.
13.	DR. W. W. BROWN,	Kabletown.

MEMBERS OF THE STATION COMMITTEE.

JOHN A. ROBINSON, JOHN G. SCHILLING,
JOSEPH MORELAND, THOMAS J. FARNSWORTH,
DR. W. W. BROWN.

PRESIDENT OF THE UNIVERSITY.	TREASURER.
E. M. TURNER, LL. D.,	JOHN I. HARVEY.

STATION STAFF.

JOHN A. MYERS, PH. D.,	Director.
C. F. MILLSPAUGH, M. D.,	Botanist and Microscopist.
D. D. JOHNSON, A. M.,	Agriculturist.
H. R. BALDWIN, Jr.,	Chemist.
A. D. HOPKINS,	Etomologist.
SUSIE V. MAYERS,	Stenographer and Book-keeper.

REPORT OF W. C. KISEN—FRANKLIN, PENDLETON CO., W. VA.

For Month of August, 1890.

Weather warm and dry. Very little rain. Frost on the 25th. No damage done. Corn not more than half a crop. Wheat half crop Oats medium. No barley. Buckwheat not harvested, but will be short. Grass good. Fruit a failure. Cattle in fine condition, but no market for them. Horses, good condition, prices low. Sheep, condition and prices good. Swine scarce. Poultry not doing well. No new enterprises being developed. The principal farming industries are raising cattle, sheep and horses. Nothing else can be made profitable without a railroad running through the county, which we have not.

REPORT OF A. W. WESTFALL—AUBURN, RITCHIE CO., W. VA.

For Month of August, 1890.

Weather changeable. Plenty of rain for vegetation. Corn about three-quarter crop. Wheat one half an average crop. Fruit almost an entire failure. Stock generally in good condition. Market good, especially sheep and poultry, no disease attacking them. No new enterprises being developed, but there are a number that could be profitably carried on in this county. Stock and grain raising are the principal farming industries. Everything except grains and fruits in fair condition.

REPORT OF J. W. CARTER—PLEASANT DALE, HAMPSHIRE CO., W. VA.

For the Month of August, 1890.

Temperature above the average. Mostly dry.

Corn promises about one-half crop. Buckwheat the same. Fruit a failure. Should frost be late buckwheat may make three-fourths crop. Wheat is being threshed and yields about as reported for last month. Condition of live stock good. Market for cattle flat. Large good horses bring good prices. Sheep high and scarce. Swine and poultry command good prices. No new enterprises being develeped.

REPORT OF W. A. MORGAN—SHEPHERDSTOWN, JEFFERSON CO., W. VA.

For Month of August, 1890.

Unusually wet, with frequent heavy washing rains. Much cold, cloudy weather. Corn growing finely and promising a heavy yield. Very little in the way of fruit of any description. Wheat on low ground inferior in quality and yield to that grown on high or rolling land. Live stock healthy and in good order, there be-

ing fine grass and pasture. Market fair to good. Stock, cattle and sheep in good demand at fair prices. Morgan Grove Agricultural and Mechanical Association growing rapidly in importance. The principal farming industries are wheat, corn, oats, potatoes and hay. Fruit marketing and dairying more profitable. Farmers much encouraged at the prospect of better prices. But fear the passage of the McKinley tariff bill.

REPORT OF R. A. ALEXANDER—CHARLESTOWN, JEFFERSON CO., W. VA.

For the Month of August, 1890.

Rather dry first of month, but have been having fine rains lately. Corn very fine. Wheat where it was not struck by hail is turning out very well and the quality is good. Live stock in fine condition and market good. The new enterprise is to boom Charlestown and Shenandoah Junctions. The principal farming industries are wheat, corn, cattle and sheep. Since the effort to boom this section, iron has been found in large quantities and good quality.

REPORT OF S. A. HOUSTON—PICKAWAY, MONROE CO., W. VA.

For Month of August, 1890.

Weathery very very,dry. Corn one-half crop. Oats one-third crop. Hay good. Pasture burnt up in many sections of the county. Rather seasonable in others. Very little fruit of any kind. Condition of live stock good up to this time. No disease among them. Market about as last year at this time. Our creamery has been established. Stock raising is the principal farming industry. All farmers have come to the conclusion that there will have to be a great change of some character before farming can be made to pay.

REPORT OF M. L. BRYTE—BRUCETON MILLS, PRESTON CO., W. VA.

For the Month of August, 1890.

Much rain during the month. Streams full; roads washed. Never knew a greater rainfall during August. Corn good generally, large acreage, best prospects for several years. Wheat not a full crop, but better than farmers thought it would be—yield better. Appearances indicate an enormous crop of buckwheat. Oats almost a failure. Grass good. Hay plenty. Condition of live stock very good generally, no diseases. Market for cattle medium; for sheep good. But few sheep unsold in the county. No new enterprises being developed, but the creamery at Terra Alta which is about completed. The principal farming industries are stock of all kinds. Wheat, corn, oats, grass and buckwheat profi-

tably raised. Creameries could be profitably introduced. The continued wet weather injured the wheat and oats. Wheat is yielding much better than farmers anticipated. Pasture excellent.

REPORT OF GEORGE T. EGBERT--RAVEN'S EYE, FAYETTE CO., W. VA.

For the Month of August, 1890.

Frequent showers of rain. Frost on 24th instant. Buckwheat promising. Corn fair. Fall pasture much improved by late rains. Fruit crop an entire failure. Condition of live stock good. No demand except for sheep, which are scarce and high. No new enterprises being developed. Stock raising is the principal farming industry.

REPORT OF ADAM FISHER—MOOREFIELD, HARDY CO., W. VA.

For the Month of August.

A little rain has fallen in the last two weeks. The corn crop will average twenty-five bushels per acre in the valleys, but on the hills will be very light. Oats less than half a crop. Wheat about one-third. Grass crop unprecedented. Live stock in good condition. Sheep in demand. Hogs unusually dull. Some inquiry for cattle. Some strangles among horses. No new enterprises being developed. The principal farming industries are grain and stock raising. Fruit an entire failure. Potatoes selling at 75 cents per bushel.

REPORT OF J. P. HALE—CHARLESTON, KANAWHA CO., W. VA.

For Month of August, 1890.

Usual summer temperature. More than average rain fall. Corn crop will be less than usual on account of late planting and too much wet weather for working. Wheat crop three-quarters crop. Oats about 90 per cent. Barley and buckwheat none raised. Grass above average. Fruit nearly a failure. Live stock condition very good. Average market. No new enterprise being developed. It is believed that Alfalfa or Mexican clover would do well here, but it has not been tried.

METEOROLOGICAL OBSERVATIONS FOR AUGUST, 1890.

West Virginia Agricultural Station, Morgantown, W. Va.

Date.	PRESSURE, Barometer and Thermometer.						Standard Thermometer.				Maximum and Minimum Thermometer.			Humidity. Hygrometer.				Clouds, Per centage of			Precipitation. Rain & Snow.			Direction of Wind.		
	7 a m	7 a m	2 p m	2 p m	9 p m	9 p m	7 m	2 p m	9 p m	av.	ma	m	R	7 a m	2 p m	9 p m	av.	7 a m	2 p m	9 m	R.	S.	av	7 a m	2 p m	9 p m
1	28.581	80	28 485	88	28 577	88	79	90	80	83	90	73	17	79	89	79	82 1	50	50	100	1	.....	29	s w	s w	s w
2	28 674	79	28 581	88	28.597	88	75	88	83	82	90	76	14	79	.....	79	79	100	25	00	1	.....	02	s e	w	s
3	28 577	84	28 568	89	28.568	87	75	90	84	83	89	71	18	79	.....	71	75	00	60	25	.....	.....	.....	s	w	s w
4	28 615	80	28 490	90	28 553	88	76	90	81	82	92	73	19	79	.....	79	79	00	10	50	.....	.....	.....	s w	w	s w
5	28 573	80	28 578	82	28 591	84	79	72	79	76	94	74	18	79	72	79	76	50	100	25	1	.....	.04	s	w	s w
6	28 701	76	28 752	85	28 824	85	79	64	79	74	81	71	10	84	78	73	78	100	50	25	.....	.....	.....	n w	w	e
7	28.750	73	28.724	85	28 706	82	69	85	76	76	85	66	19	69	85	76	76	50	75	100	1	.....	.14	n w	n	s e
8	23.642	75	28 748	81	28.642	87	71	81	77	76	81	66	18	79	79	79	77	100	25	00	1	.....	1.26	n	n	s e
9	28 726	72	28.602	81	28 706	85	71	80	74	85	82	67	15	79	.....	89	84	100	80	0[illegible]	.....	.....	.....	s	s w	s
10	28 536	79	28 5[illegible]8	82	28 624	76	74	80	69	74	81	69	12	79	63	79	73	100	50	25	.....	.....	.....	n e	n w	s w
11	[illegible]8 706	61	28 748	74	28 624	76	52	73	66	63	78	55	23	76	73	66	71	80	50	00	.....	.....	.....	n w	n w	n w
12	28.812	58	28.714	79	28 748	76	55	75	68	66	74	53	21	76	70	78	74	00	10	00	.....	.....	.....	n	n	n
13	28 812	63	28.754	79	28.708	76	58	78	73	69.6	75	52	23	88	71	79	79.1	00	40	80	.....	.....	.....	n e	n w	n w
14	28 746	75	28 614	73	28 724	74	69	72	70	70 3	78	56	22	60	79	88	75 2	75	[illegible]0	100	.....	.....	.....	s e	s w	e
15	28 744	71	28.716	78	28 838	79	68	72	79	73	70	66	4	88	71	63	74	100	50	00	1	.....	.03	n w	n w	s e
16	28 8[illegible]0	68	28 828	83	28.842	81	64	84	75	74	80	66	14	88	64	79	77	00	00	00	.....	.....	.....	s w	w	s w
17	28 854	77	28 828	84	28.842	80	61	84	75	74	80	66	14	88	64	89	80	5	50	80	1	.....	.47	s w	s w	s w
18	28.804	73	28.736	77	28.742	73	72	73	74	73	85	67	15	89	89	89	89	100	90	30	1	.....	.10	n	n	n w
19	28.804	74	28.7[illegible]6	78	28.742	77	72	73	74	73	75	67	8	88	79	88	85	5	7[illegible]	100	1	.....	.10	n e	s w	s e
20	2[illegible].735	76	28 720	77	28 728	78	73	76	74	74	80	74	6	89	89	89	89	100	90	70	3	.....	.97	n	n w	n e
21	28 652	76	28 532	76	28.604	76	79	70	70	73	79	70	9	89	79	89	85.2	80	90	50	2	.....	68	s w	s w	s w
22	28.640	72	28 634	74	28.675	75	65	65	65	65	78	66	12	68	78	80	75	50	80	70	3	.....	.81	n	n w	n w
23	28.826	71	28.728	70	28 802	71	55	69	57	60	79	51	28	75	68	78	73	5	20	30	.....	.....	.....	n	n w	n
24	28 874	66	28.742	72	28 715	73	48	70	64	61	68	46	22	87	68	77	77	100	25	50	.....	.....	.....	n	n w	n e
25	28 642	67	28 626	69	28.648	68	59	70	68	65	69	57	12	88	88	88	88	60	80	10	.....	.....	.....	n	s w	s
26	28 616	75	28.508	76	28.446	75	67	77	73	72	78	58	20	89	89	89	81	60	20	100	2	.....	.67	s e	s w	s w
27	28 532	76	28.546	76	28.628	76	68	75	71	71.3	76	65	11	88	71	79	79.1	90	80	70	2	.....	.22	w	s w	s
28	28.722	70	28 636	77	28 628	76	63	76	70	69 6	76	60	16	88	71	89	82.2	00	75	10	.....	.....	...	s w	w	s w
29	28 612	70	28 524	77	28 512	76	60	78	68	68.6	75	57	18	88	81	79	82.6	00	25	40	1	.....	.17	w	s w	s w
30	28 628	65	28.548	78	28.728	75	64	73	66	67.3	78	61	17	88	63	88	79 2	100	80	20	1	.....	.01	s w	n	n
	28 824	66	28 820	63	28.806	71	53	69	61	61	72	51	21	88	89	79	85.1	75	75	00	.....	.....	.....	n	n w	n
	28.964	72	28.656	79	28.688	78	67	76.8	72.3	72 1	92	46	46	82	76.2	80,8	79 6				23		5.93			

BULLETIN NO. 11

OF THE

WEST VIRGINIA

Agricultural Experiment Station.

SEPT. 1890:

I. Meterological report for September.

II. Reports of Correspondents upon Meteorology and Crops for September.

BY JOHN A. MYERS,

DIRECTOR.

The Director does not hold himself responsible for the opinions expressed by Correspondents.

CHARLESTON:

MOSES W. DONNALLY, PUBLIC PRINTER.

1890.

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A. D. HOPKINS, - - - - - - Entomologist.

SUSIE V. MAYERS, - - Stenographer and Book keeper.

METEOROLOGICAL OBSERVATIONS FOR SEPTEMBER, 1890.

West Virginia Agricultural Experiment Station, Morgantown, W. Va.

Date.	Pressure Barometer and Thermometer Reduced to Freezing Point. 7 a m	7 am	2 p m	2 pm	9 p m	9 pm	Humidity Hygrometer. 7 am	2 pm	9 p m	Av	Standard Thermometer. 7 a m	2 p m	9 p m	Av	Maximum and Minimum Thermometer. Max.	Min.	Range.	Clouds, Pecentage of. 7 a m	2 p m	9 p m	Av	State of Weather. 7 am	2 pm	9 pm	Precipitation.			Direction of Wind. 9 am	2 pm	pm
1	28.936	64	28.922	72	28.922	72	75	78	88	77	52	68	65	61.6	70	49	21	......		......	......	cl	cl	cl				s e	n	n
2	28.938	61	28.836	71	28.814	79	87	71	88	82	57	77	70	68	75	56	19	......	60	......	20	cl	m	cl				n	s w	s e
3	28.914	68	28.814	82	28.842	79	88	72	79	79	60	82	73	71.6	79	55	24	......	......	......		cl	cl	cl				n	s w	n
4	28.842	69	28.732	83	28.750	81	88	80	79	82.3	61	83	77	75.3	82	61	21	......	60	15	25	cl	m	c				n w	s w	n
5	28.832	76	28.758	81	28.736	81	88	99	89	89	71	80	75	75.3	84	62	22	100	100	100	100	cov	cov	cov	2		.19	s w	s w	e
6	28.722	77	28.704	77	28.744	78	89	89	89	89	75	75	75	75	80	70	10	100	100	......	66	cov	cov	cl	2			s	s w	e
7	28.714	72	28.706	82	28.722	81	89	[illegible]	79	82.6	74	84	77	78.3	75	71	4	50	......	25	25	m	cl	c			1.46	s w	w	s e
8	28.724	79	28.712	87	28.732	83	89	72	82	81	71	87	81	76	84	67	17	25	25	100	50	c	c	cov	1		.07	s w	s w	s w
9	28.752	78	28.724	80	28.736	83	89	80	89	86	74	82	76	77	87	70	17	100	50	100	90	cov	ov	cov	2		.63	s w	n	s w
10	28.736	77	28.732	84	28.702	82	89	89	89	89	74	84	76	79.3	80	72	8	100	75	80	55	cov	ov	ov	1		.86	n	n	n
11	28.746	75	28.616	82	28.722	80	85	80	89	85.6	69	85	77	70.5	84	66	18	75	31	80	61	ov	c	ov	1		.04	n	s w	n
12	28.622	74	28.758	80	28.602	79	79	90	89	86	72	80	75	78.6	84	67	17	100	80	100	93	cov	ov	cov	1		.31	s w	s w	s e
13	28.548	74	28.548	77	28.712	76	83	88	88	88	70	74	67	71.6	70	74	67	100	70	100	90	cov	ov	cov	3		.27	s	s	s
14	28.732	60	28.714	74	28.724	70	76	79	88	81	58	74	69	67	74	56	18	75	75	......	50	ov	ov	cl				n	s w	s
15	28.646	66	28.634	76	28.648	72	89	89	89	89	75	78	72	74.6	72	56	16	25	50	40	30	m	m	c				n w	s w	s w
16	28.636	68	28.608	74	28.638	66	78	79	83	80	67	75	67	79.6	78	63	15	80	70	......	50	ov	ov	cl	2	1	.67	s w	s	s
17	28.732	63	28.712	70	28.732	68	83	88	78	83	62	71	65	63.4	73	62	11	100	75	75	83	cov	ov	ov				n w	n w	n w
18	28.804	60	28.721	74	28.728	66	88	79	88	83	59	75	65	69	71	56	15	......	......	......	......	cl	cl	cl				n w	n e	n w
19	28.716	58	28.522	70	28.656	70	87	63	89	79.6	57	79	71	63	75	55	20	......	50	100	50	cl	m	cov	1		.18	s w	s w	s w
20	28.832	62	28.938	68	28.838	60	77	78	76	77	60	66	57	64.3	78	55	23	70	60	20	50	ov	m	c				n	n	n
21	28.738	52	28.728	72	28.712	64	86	73	63	74	50	73	63	60.6	67	49	18	......	......	......	......	cl	cl	cl				n e	n	n
22	28.744	64	28.708	71	28.748	72	88	88	88	88	59	69	66	64.6	73	48	25	100	100	100	100	cov	cov	cov				n	s w	s
23	28.742	74	28.638	76	28.744	73	88	63	88	79.6	60	76	63	67	67	58	9	......	......	30	10	cl	cl	c				s w	s	n
24	28.838	61	28.822	72	28.852	68	87	78	76	80.3	54	70	57	61.6	76	52	14	......	......	......	......	cl	cl	cl				n	n	n
25	28.828	58	28.724	75	28.712	71	79	79	79	79	54	74	65	60.5	68	53	15	......	......	......	......	cl	cl	cl	1		.03	n	e	n w
26	28.634	65	28.542	71	28.632	72	88	88	88	83	62	67	67	65	73	52	21	100	100	100	100	cov	cov	cov	2		.99	s e	s w	s w
27	28.624	70	28.704	64	28.822	66	88	77	87	84	55	50	65	56.3	68	59	9	100	100	100	100	cov	cov	cov	3		.16	n	n	n
28	28.712	61	28.848	68	28.836	66	74	67	76	72.3	47	61	55	53.2	63	45	18	......	......	......	......	cl	cl	cl				n	n	n e
29	28.828	56	28.812	73	28.816	68	77	77	77	77	48	65	60	54.5	63	45	18	......	75	75	50	cl	ov	ov				e	e	n
30	28.836	61	28.838	69	28.812	71	79	79	79	79	54	64	62	57.3	63	47	16	90	80	100	90	ov	ov	cov				e	n e	n
	28.754	66.7	28.725	75.1	28.746	76.5	84.6	79.4	83.5	82.5	62.1	74.3	68.4	68.2	Highest. 84	Lowest 45	Range. 39	48.	47.5	45.	45.1				22		5.86			

REPORT OF GEO. T. EGBERT.

RAVEN'S EYE, Fayette Co., W. Va.

For Month of September, 1890.

Have had frequent rains during the month. Corn up to the average. Buckwheat fair. Grass excellent. Delay in frost has allowed corn to mature. Condition of live stock good. Market for cattle slightly improved, although the supply is far in excess of demand. Sheep scarce and high. No new enterprises being developed.

REPORT OF J. P. HALE.

CHARLESTON, Kanawha Co., W. Va.

For Month of September, 1890.

Weather pleasant and seasonable. Rainfall a little more than average. No snow. Corn crop less than usual on account of late planting and too much wet weather for working. Wheat about three-quarter crop Oats about ninety per cent. Barley and buckwheat none raised. Grass above average. Fruit nearly a failure. Condition of live stock about average. Market about average. No new enterprises being developed. It is believed that Alfalfa or Mexican clover would do well here but has not been tried.

REPORT OF S. A. HOUSTON.

PICKAWAY, MONROE Co., W. VA.

For Month of September, 1890.

Weather very dry, only one decent shower. Condition of corn one half crop. Wheat one-half crop. Grass in some parts of county burnt up. Oats one-third crop. No fruit. No barley raised Buckwheat very much injured. Stock not as fat as usual at this season; troubled to some extent by horn fly. Market low. Creamery and Improved Mills are the new enterprises here. The principal farming industry is stock raising. It does not pay to raise a surplus of any crop at present prices.

REPORT OF EUGENE BAKER.

LEETOWN, JEFFERSON CO., W. VA.

For the Month of September, 1890.

Weather cool with slight rain. Corn not up to the average. Wheat about average. Grass looking well. Began seeding wheat about September 21st and cutting corn at the same time. Very few apples, grapes or pears. No peaches. All kinds of stock looking fairly well and seem to be in healthy condition. Market slow. A canning factory about to be established and the ore beds are soon to be worked, are the new enterprises being developed. The principal farming industries are grain and stock raising, creameries, canning factories and the raising of tobacco. Our county fair showed an increase in machinery, live stock and farm products.

REPORT OF W. E. KISEN.

FRANKLIN, PENDLETON, CO., W. VA.

For the Month of September, 1890.

The weather has been fine, with plenty of rain. Corn one-half crop. Wheat one-half crop. Oats light. Buckwheat light, not more than one-half crop. Grass good, above average. Fruit entire failure. Cattle in good condition, prices low. Horses in good condition, no demand. Sheep, prices good. Swine scarce and high. Poultry scarce. No new enterprises, but there is a company now being organized to boom the county. Stock raising the principal farming industry.

REPORT OF R. A. ALEXANDER.

CHARLESTOWN, JEFFERSON CO., W. VA.

For Month of September, 1880.

Weather moderate. Corn, wheat and grass very good. Live stock in fine condition. Market fair. The Land Improvement Company is the only new enterprise being developed. Wheat and corn are the principal farming industries, and I think our county as well adapted for raising tobacco as Lancaster county, Pennsylvania, if the farmers can be induced to try the experiment.

REPORT OF LEE H. MOLER.

MOLER'S, Jefferson Co., W. Va.

For Month of September, 1890.

Condition of weather wet and murky. More than one-half

the time have had rainfall. Corn fair, average crop. Wheat not up to average yield. Fall pasturage in excellent condition. Cattle, &c., in prime condition, except distemper in mild form in certain localities among the horses. Some little demand for cattle and horses. Sheep scarce and in demand The principal farming industries are wheat and corn.

REPORT OF ADAM FISHER.

MOOREFIELD, Hardy Co., W. Va.

For the Month of September, 1890.

Condition of the weather warm and rainy. Corn about half crop, say twenty five bushels per acre on river bottom; hills very little. Oats light. Hay abundant and good. Fruit none. Condition of stock good. Sheep in demand Other stock dull. No diseases among them. A large tannery will be built near Moorefield at once. It is the only new enterprise. The principal farming industries are corn, hay and stock raising.

REPORT OF S. R. HANEN.

GLEN EASTON, MARSHALL CO., W. VA.

For Month of September, 1890

Weather bad. Unfavorable for work. Excessive rainfall for September. Corn about 65 per cent. Droughts in July, damaaged by wind in August and rain in September. No wheat sowed yet. Fruit crop entire failure. Grass abundant Condition of live stock good generally. Sheep in demand with good prices offered. Horses fair price Swine fair, average price. Cattle, thrifty, but prices low. The principal farming industries are in raising corn, wheat, oats and hay.

REPORT OF W. A. MORGAN.

SHEPHERDSTOWN, JEFFERSON CO., W. VA.

For the month of September, 1890.

The weather has been unusually warm with frequent rains. The corn is now being cut. It shows a good crop from the appearance in the field; it seems to be well matured and stand well in the shocks. Live stock in good condition. The market for cattle and hogs good, and for sheep too, but supply is insufficient to demand. Pasture in fine condition. The old "Shannondale Springs," a watering place, has been rebuilt recently as a summer resort. The only enterprise developed since last report. Wheat,

corn, oats and potatoes, &c , are the principal farming industries, and the prices are better than usual. Farmers feel encouraged at the prospect of better prices and better legislation for them in the future.

REPORT OF J. W. CARTER.

PLEASANT DALE, Hampshire Co., W. Va.

For the Month of September, 1890.

Weather seasonable. Quantity of rain above average. Quite warm. No frost yet. Corn well matured. About one-half crop. Buckwheat will make about three-quarter crop Pasture good. Condition of live stock good. Some poultry have cholera. Market good for large horses. Cattle dull. Sheep scarce and high. Swine active. Poultry brings good prices. The building of a large Roller Flouring Mill, Sash Factory and Woolen Mill at Romney is now being contemplated by the Romney Land Improvement Company.

REPORT OF A. W. WESTFALL.

AUBURN, Ritchie Co., W. Va.

For Month of September, 1890.

A great deal of rain fell during the month. Corn in a much better condition than was expected a month ago. Buckwheat almost an entire failure. Grass good. Fruit in a bad condition. Stock of all kinds in a fair condition. No diseases attacking them. Market good for horses, sheep and poultry. Market for swine fair, but not as good as this time last year. The new enterprises being developed in our county are lumber and oil business. The principal farming industries are grain and stock raising. In short the county is in as good condition as could be expected.

Bulletin No. 12.

OF THE

WEST VIRGINIA

Agricultural Experiment Station

MORGANTOWN, W. VA.

THE CANADA THISTLE.

C. F. MILLSPAUGH, M. D.

Botanist and Microscopist.

JOHN A. MYERS, Ph. D.

Director.

DECEMBER, 1890.

CHARLESTON, W. VA.
Moses W. Donnally, Public Printer.
1891

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8.	M. J. KESTER,	Union.
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A. D. HOPKINS, ... Sp'l Agt. Entomology.
SUSIE V. MAYERS, . . Stenographer and Book-keeper.

C. F. MILLSPAUGH, PHOTO.

CANADA THISTLE
(One Year's Growth.)

THE CANADA THISTLE.

(*Cnicus Arvensis* (L) *Hoffm.*)

There is probably no weed in the United States that attracts more fully the attention of the agriculturist, or is looked upon with so much disgust by him, as this miserable European immigrant ; which came to our shores early in the history of their civilization, and has made itself so much at home.

The anxiety so strongly felt in this State on its account, is rightly exercised ; for there is no greater vegetable bane to the lands, nor one harder to be rid of once it gains a rooting. This anxiety has already led to the mistaking of several of our less injurious weeds for this species, and gives impetus to a careful consideration of the plant at our hands. I am gratified to be able to say, that upon my many trips about the State, two stocks only of this vile weed have been met with (these were immediately destroyed)— proving that our task of keeping it entirely out is not a great one, and needs but a little knowledge of its character, and watchfulness over our fields. to crown with success. It is to the present scarcity of this plant that this special bulletin is due, recognizing as we do that more than ever in this instance the old saying about the timely stitch and its results is true.

The Canada Thistle is so widely different from any other growing here, that once seen and observed it need never after be mistaken. Its slender, rigidly erect stem, branching only near the top; its long and narrow prickly leaves ; its numerous and small rose purple flower heads ; and its extensively creeping roots, serve as characters not to be seen in any other form to which the name thistle might be applied. In the reproduction of the photograph here given, the

plant is reduced three times, and represents about one-third of the whole stem from which it was originally broken. The thistle thus grows from 2 to 3½ feet tall.

While in Randolph County making inquiries concerning this weed, two plants were pointed out to me as the Canada Thistle neither of which bore the least likeness to it. One of these plants was the Teasle, (*Dipsacus sylvestris, Mill*), a stout prickly stemed plant, having a few long-spined, dense heads about two or four inches long. This plant is another European gratuity for which we return no thanks; although it is probably our fault that it is with us, it having been brought here and cultivated that its heads might furnish cheap instruments for carding wool. This species has become a pernicious weed along road sides and waste places, where it grows plentifully throughout most portions of the state. The Teasle is easy to eradicate; cutting and burning before the seeds mature will soon remove it entirely from the land.

The other weed shown me as the Canada Thistle was the Blue-weed or Blue Thistle, (*Echium vulgare, L.*,) still another European tramp, which however bears no resemblance to the thistle, but which should by all means be as rigidly rooted out and as carefully destroyed. The Blue-weed may be known by its reddish-purple or brilliant blue flowers arranged in small close groups upon one side of each of the numerous branches. This plant grows in clumps about two feet high, and is entirely covered with bristly hairs, not prickles like in the thistles.

One other true thistle has often been mistaken for the Canada Thistle in this State, especially as (in the localities where I have heard it spoken of) it is of rather recent appearance. This is the Virginia Thistle, (*Cnicus Virginianus, Pursh.*,) readily recognized from the Canada Thistle by its large heads which tip the ends of long and naked branches, branchlets or probably peduncles, and its larger leaves being closely woolly beneath.

In drawing distinctions thus carefully, I do so to identify the Canada Thistle in such a manner that the agriculturist, may with a little observation, distinguish it; not meaning but that it is best to as fully destroy each and every one of the plants mentioned, as all are veritable pests, and should be as carefully exterminated as the Canada Thistle itself.

The life history of the Canada Thistle may be summarized as follows:

The seed, on germinating the first year, throws up a luxurious rosette of softly green leaves which clings closely to the soil or sod, no upright growth being produced. This and its enlargement represents one full seasons' growth. [See plate 9.]

The second year a new and more vigorous crown is added to this rosette, and from the center of this one or more lusty stems spring with a business-like mein. These stems throw off numerous leaves below and leafy branches above, which in due time put forth a profusion of flower heads in which the seed are rapidly matured. Here let me remark in italics: *Never trust a weed of this family after cut-*

CANADA THISTLE.

ting it down when in flower, for it will more frequently than otherwise ripen its seed sufficiently after cutting to reproduce. Burn it every time!

Close observation, however, reveals immediately that this is not all of the growth of the second year. While upon the surface of the ground a great show is being made of stem, leaf, and flower, a secret mission is accomplished below: a mission dark and threatening to our peace, for the roots are forming new rosettes at little distances from the parent plant, similar and complete as did the seed the first year. These, if left to grow, will progress next year causing trouble upon trouble with never ceasing multiplication.

Now, having a knowledge of all this, what is the best method for eradication to be employed in West Virginia, where the plants are now few and amenable to treatment?

Cut down and uproot carefully, every plant that bears any resemblance whatsoever to the picture in this bulletin, and burn it directly upon the spot it grows. The larger the fire, the better, it would be more profitable to use a barn or two for fuel than to allow this weed to grow and mature its seed.

Watch this spot the following season, look for the green prickly rosettes, if they appear turn them out carefully, and thoroughly, with a fork, hand-pick every rootlet in the earth so turned, and build another fire for them. Leave not so much as a fibre in the ground, and your labor will be repaid an hundred fold by complete rest on account of this weed in the future.

If at any time you desire information upon any plant of your farm or disease affecting the same, we will answer as fully as possible within our knowledge any questions you may see fit to address us either by letter or in person. In questioning us concerning a plant or disease, it is necessary however to send us a specimen of the same when possible, that no confusion as to species or misunderstanding of your description may arise. To do this wrap the green plant up in a whole newspaper and mail it to us. Postage rate one cent for two ounces.

It is my intention to issue during the coming season a complete account of the weeds of this State. To do so intelligently and honestly, I need the help of every West Virginian Agriculturalist who reads this article. I am only one man and can not conscientiously cover the whole State. I therefore ask you, for the benefit of your farms, to assist be by answering in pencil the question upon the last sheet of this bulletin, tearing the page out afterward and mailing to the West Virginia Agricultural Experiment Station, Morgantown, W. Va.

By doing this now, while, as I hope, you are interested in the subject, you will recive in return through the bulletins of this Station, the benefit of your neighbor's observations throughout the State.

1. What are the worst weeds upon your farm and roadsides...
....
....
Write them in the order of their badness, beginning with the worst. When you mention one weed under two or more names, put all these names in brackets, as I have done under the 7th question.

2. Have you seen the Canada Thistle in the State; if so, where, and how much of it ?.....................................
....

3. What do you do with your weed crop? Do you cut them? When? Do you compost them? How? or do you burn them?...
....
....

4. Do you ever use any chemical or other remedies against weed growth? If so, what and for what weeds?................
....
....

5. Do you consider any of your weeds good fodder, if so, which and for what animals?...................................
....

6. Have any new weeds come to your farm lately? If so, please describe them carefully, giving the name you know them by
....
....

7. Please draw a pencil mark through each of the following weeds that are now on your farm.

Burdock, Mullin, (Butter and Eggs, Toad Flax, Jacobs' Ladder) Pig Weed, Rag weed, Worm Wood, Shepherds' Purse, (Soap Wort, Bouncing Bet) Corn Cockle, (Evening Primrose, Wild Beet) Wild Carrot, Cows' Bane, Common Elder, Teasle, Iron Weed, (Queen of the Meadow, Quill Wort) White Top, Godden Rod, Clot or Cockle Burr, Spanish Needles, Dogs' Fennel, (Yarrow, Millefoil) Oxe-eye Daisy, Fire Weed, Common Thistle, Virginia Thistle, Tall Thistle, Sow Thistle, Common Plantain, Rib-wort Plantain (Viper's Bugloss, Blue Devils, Blue Thistle) Beggar's Lice, Bind Weed, Wild Sweet Potato, (Jimson Weed, Jamestown Weed, Stink Weed) Horse Nettle, Indian Hemp, (Dogs'-bane, Wild Cotton) Poke Root, Milk Weed, Bitter Dock, Skunk Cabbage, Field Garlic, (Broom Sedge, Nut Grass) Cheat-grass, Chess.

In cases where you do not know what plant is meant by the name here given, please draw a circle around that name.

8. What plants of your farm or woods do you use for family medicines, and for what ailments?................................
....
....

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Bulletin No. 13

OF THE

WEST VIRGINIA

Agricultural Experiment Station.

MORGANTOWN, W. VA.

THE CREAMERY INDUSTRY.

—BY—

JOHN A. MYERS, Ph. D.
Director.

JANUARY, 1891.

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THE CREAMERY INDUSTRY.

The conditions under which we are attempting to develop the creamery industry in this State, are different from those existing in the sections of the country, in which the bulk of the published work upon this branch of industry has been done.

Our experience leads us to disagree in several particulars with accepted ideas promulgated by competent authorities upon the best methods of handling milk and cream for the manufacture of butter. We are quite clear that some of the principles promulgated by our friends further north, and generally accepted as true, are not the most applicable in this latitude and farther south. We have not concerned ourselves with the manufacture of cheese, with the concentration and canning of milk, nor with the utilization of any of the by products. Our skim milk goes for feed, and our cream is either disposed of as cream, or as butter. The energies of the Station in this investigation have been concentrated upon the problems of handling milk and cream, so as to make the butter business profitable to the farmer.

Elsewhere, much attention has been given to the raising of cream, and to the care with which milk should be handled before going to the churn, and to the vessels, whatever their character may be, for raising the cream and for skiming it.

According to those pursuing what I may term the old plan, the milk must be subjected to the most careful treatment. Where milk must be kept for hours for the cream to rise, the danger of its becoming contaminated is correspondingly increased. I apprehend, that too much stress has not been laid upon the necessity of having all vessels containing the milk scrupulously clean. The air, room, water, and everything near where the milk is kept, should under that system, receive careful attention, and be freed from every contaminating influence.

The effect of temperature upon milk is felt in three directions:

1st In the ratio of skimming, or the extent to which the total butter fat in the milk is secured in the cream.

2nd. In the volume per cent. of the cream, or the relation that the volume of cream bears to the volume of milk.

3rd In the composition, or fat content of the cream.

In regard to the first, the ratio appears to become greater as the temperature is higher. In regard to the second, the per cent. is greater as the temperature is lower, and as regards the third, the per cent. is greater as the time is lon er. Then, the questions of the character of the vessels in which the milk is kept; the agitation that the milk receives: the food of the cattle, the breed of the cattle, and many other conditions enter into the question which it is not necessary for me to discuss at length, as those particularly interested in this form of dairying have given it ample attention.

The cream by this system may be skimmed by what is known as the deep-setting process, or by the shallow setting process. Under the head of deep setting process, there are numerous forms of pat-

ent vessels intended to facilitate the rising of the cream and the removal of the milk and cream from the jars, and to regulate the temperature so as to secure the most favorable conditions for obtaining all of the cream from the milk. Among the deep setting systems, I may mention The Cooley Creamer, The Haney Patent Cream Setter, Common Sense Cream Setter, Crescent Creamery and Refrigerator, Excelsior Cooling Vat, Moseley's Occident Creamery and Stoddard Creamery. The cans are generally about 8 inches in diameter and from 18 to 20 inches in height, usually with a glass window or some device upon the side which carries a scale in inches and fractions to facilitate the determination of the quantity of cream raised. The Cooley system entirely submerges the can in cold water. The Stoddard sets the can deeper in the water than the milk rises upon the inside of the can. Other systems of raising cream by deep setting usually employ either the one or the other of these methods, but produce some modifications in the method of taking the cream from the can.

The shallow setting system is practiced by the use of shallow tin pans or crocks, or occasionally wooden vessels placed in cold water, or cold dry air where the cream is allowed to rise, and is then skimmed off with a ladle or large spoon.

Whatever the system used, it is important that the milk be placed in the can as soon as possible after it is drawn from the cow, and should not be agitated any more than can be avoided during cooling. The temperature should be reduced to as near 42 degrees F. as possible. If the spring water will not cool the milk to at least 48 degrees F., ice should be used. The deep setting system is perhaps the more perfect, and represents the latest improvements in handling milk by this process. It works very satisfactorily whenever ice can be had at nominal cost, or where there is abundance of cold water. In either case, if the temperature be not reduced sufficiently the separation of the cream is liable to be imperfect, and a considerable per cent. of the butter fat in the milk may not be secured. In Ohio county in this State where it was tried upon quite a large scale, it proved unsatisfactory to the farmers. Few if any of them preserving ice, and the springs generally not being cold enough in the summer to sufficiently cool the milk.

Creameries using this system usually collect the cream at stated periods and pay the farmer a contract price for the cream according to its quality. If our farmers could be inducd to store ice, it would, no doubt be satisfactory in this section, as it is farther north. But we believe that in this latitude and farther south, it will be better to adopt another method, and rely upon the centrifuge to overcome the climatic difficulties, which it does most fully.

By adopting this system, we do away with the instructions so minutely given in regard to handling the milk. The farmer sees that his milk pails and cans are kept clean and fresh, and gives himself no farther trouble about the milk after it is delivered fresh to the creamery. The creamery-man and his machinery do the rest. If the farmer wishes his skim-milk for domestic uses or for feeding

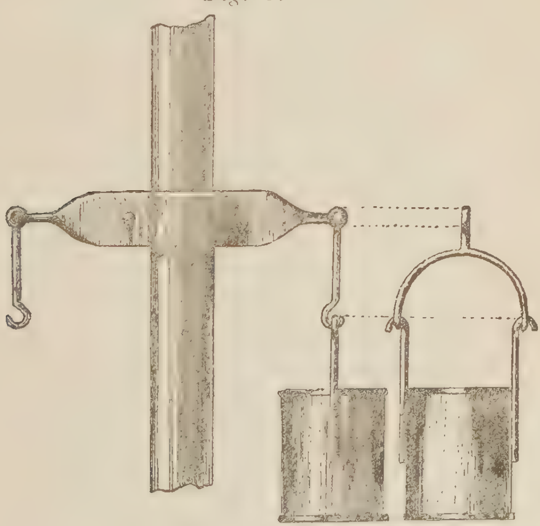
calves or pigs, he can arrange with the creamery for as much as he wishes.

He delivers his milk and is paid for it by the creamery according to the quality and quantity of milk supplied.

The theory of the rising of the fat globules of the cream to the surface is very simple. Cream rises because the fat globules of which it is composed are slightly lighter than the liquid in which they are suspended. This very slight difference in weight is more marked in some cases than in others, probably due to the larger size of the fat globules in some kinds of milk. The rising of the globules is retarded by the serum of the milk which gets stiffer and stiffer as the milk cools, increasing its vicosity, causing the cream to raise slower and slower. The effect being such that if after it is completely cooled the milk be well agitated, much of the cream fails to again rise to the surface, being detained in the body of the liquid by the serum.

The history of the separation of cream from skim-milk is interesting, as showing the manner in which all of our improvements in the arts and sciences are brought about. The centrifuge, as is the case with most great inventions, is not the result of a sudden, brilliant idea; but represents a growth, and is the cumulative effect of a number of efforts to accomplish the separation of cream by mechanical methods. The first effect in this direction appears to have been made by Prof. Fuchs, of Karlsruhe,, in 1859; the method employed by him being simply for testing milk. In 1864, Bayern Antonin Prandtl devised the centrifugal method which consisted of an

Fig. 1.



PRANDTL'S CENTRIFUGE OF 1864.

upright shaft to which arms were attached, upon which buckets containing the milk could be swung. This shaft attached to proper

machinery, and made tc revolve at great speed caused the buckets to swing out at right angles, and the centrifugal force in turn caused the cream to rise upon the milk in the buckets, enabling it to be skimmed off by means of a ladel. By running this machine about 400 revolutions per minute, the cream could be made to rise quite perfectly in from 15 to 18 minutes, and by continuing the operation still farther, the cream assumed a thick constituence tasting somewhat like butter‡.

No further developments in this line appear to have been made until about 1872, when Prof. Moser, of Vienna, at the Dairy Exposition in that city exhibited a model for the separation of cream by centrifugal force. This machine was somewhat elaborated by Lefeldt, and constructed for handling milk upon a large scale; being exhibited at the Agricultural Exposition of Bremen in 1874. Lefeldt, instead of swinging buckets as Prandtl did, caused metalic cylinders to be attached to the revolving axis. This, however, did not have any practical result so far as its influenae upon the dairy industry was concerned. In 1875, Prandtl brought out an improvement, which provided for the continual skimming of milk by centrifugal action.

This, like the earlier invention, produced no practical results. W. Lefeldt, of Schœningen overcame in 1876 some of the dificulties existing in previous machines, and succeeded in devising a practical machine applicable to the rapid separation of milk and cream. The Lefeldt machine may be considered the original model from which various forms of centrifuges now in use are derived by effecting modifications. It consisted of an iron cylinder driven by steam power at a high speed, into which milk was delivered through an opening in the center at the top. The drum was provided with proper arrangements for enabling it to run evenly upon a small axis or point of support. By causing the cylinder to revolve at a speed of from 800 to 1,000 revolutions per minute, the milk in the cylinder is made to stand upon the outside rim in bands corresponding to the Molkerewesen S. 344 specific gravity of the milk; the cream which is lighter, forming the band next to the center of the cylinder, while the skim-milk which is the heavier, takes position nearest the outside of the cylinder. This is the principle upon which all of the centrifugal machines act. The more rapidly the machine revolves, the more perfect the separation. After running this machine for some time in order to complete the separation, it was disconnected from the engine, and the cylinder allowed to come to a standstill, when the skim-milk would settle to the bottom of the cylinder, and the cream, as the motion checks, will settle to the center and rise to the top. By syphoning off the skim milk, the cream is left in the bottom of the drum, from which it could be rinsed out either by water or skim-milk. The machine required at least an hour to separate 100 quarts of milk, and presented the difficulty that it had to be stopped and emptied every time it was full and the separation completed.

‡Dingler Polytechnisches Journal Bd. 174, S. 149,

In 1877 Lefeldt devised an arrangement by which the cream could be separated while the machine was in motion. The cream was skimmed off by introducing a tube in such a position that it would reach the cream as it was separated and rose in the drum. The capacity of this machine was sufficient to lead to its introduction into the first organized creamery at Kiel in 1877, the milk being collected from a number of small farmers at some distance from Kiel and brought to the creamery, which provided the city with a supply of pure milk and butter, and might be considered the first creamery organized for the separation of cream by means of centrifugal force.

It was still necessary to stop the machine to remove the skim-milk, and while a great advance in the application of centrifugal force to the separation of cream had been made, still many defects were apparent. Various improvements were then introduced into the centrifuge, and in 1879 DeLaval brought out what he called a separator, which is now in general use in the creameries of the country, being more or less modified and improved by recent inventions.

Fig. 2 represents the DeLaval separator, which is driven by a band connected with a pulley run by an engine. The speed of these machines has been increased from a few hundred at first to several thousand revolutions per minute. The bowl of the DeLaval separator are tested to 10,000 revolutions per minute, and all of the separators in the market have their bowls or cylinders tested to a very high speed before they are sent from the factory. The centrifugal force at these high rates of revolution becomes so great that it is dangerous to run the machines beyond the speed to which they are tested. Serious damage in several cases has been brought about by persons running them beyond the proper speed and causing the bowl to burst. Those not familiar with running these machines should not attempt it without having some facilities for determining the speed at which they are being driven.

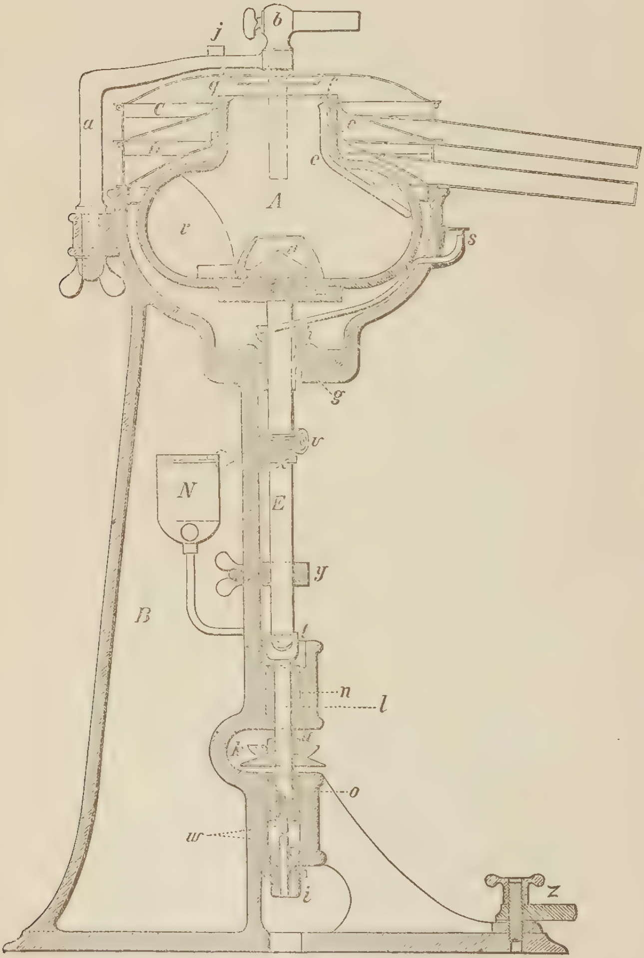
The pressure upon a twelve inch bowl running full of milk at 7,000 revolutions per minute is enormous, amounting to 21,000 pounds to a square inch of cross section. The weight, or tendency of one ounce of metal within the bowl to fly from the center is 562 pounds or over one-fourth of a ton. The constant tendency to tear a wing weighing two ounces from the soldering would consequently be over one-half ton. By a law of mechanics, the centrifugal force increases as the square of the speed. Thus, at 10,000 revolutions, the pressure would be fully double that at 7,000.

At 100,000 per minute, if the distance traveled by the bowl could be drawn out in a straight line, it would be more than six miles a minute. The best cast iron free from flaws would burst at a speed of about 6,000 revolutions per minute. Malleable iron at a little higher speed ; but the cast steel of which the bowls in the De Laval separator are made have the tested tensile strength of 42,000 pounds or twenty-one tons per square inch: It is not surprising, therefore, that great damage is done when the creamery man is so foolish as

to run the separator at a speed of over 10,000 revolutions per minute. We have run our separator up to a speed of about 9,000 revolutions per minute to test it ; but in ordinary operations it is run at 6,000 to 7,000 per minute.

There are in this country at present two prominent machines which we will explain in this connection, as the majority of the farmers in this State are unfamiliar with the principles upon which they act. The cut represents a section of the De Laval Separator, and we are

Fig. 2.



SECTION OF THE DE LAVAL SEPARATOR.

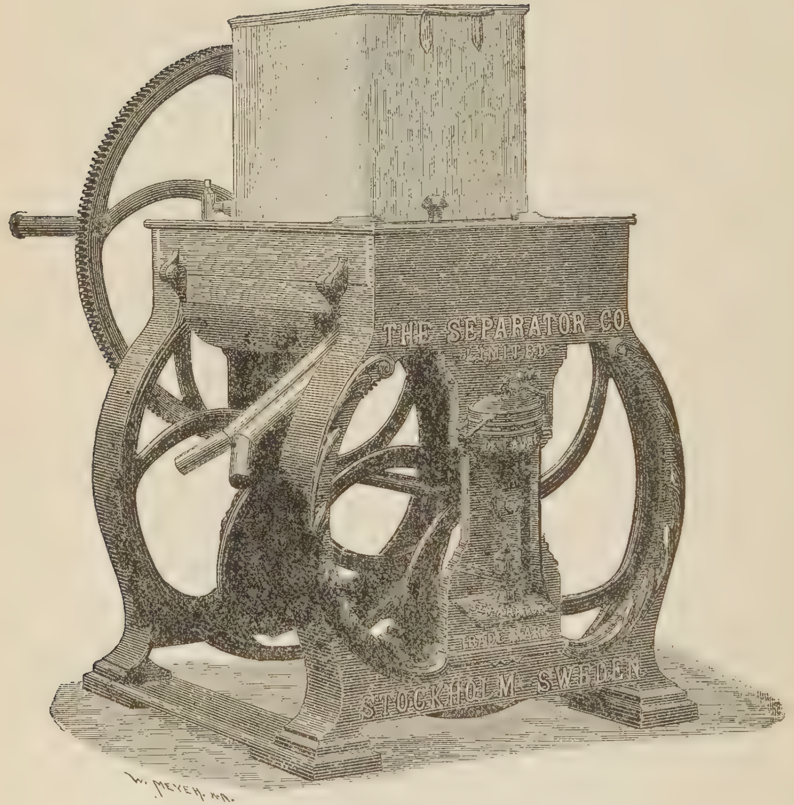
looking at it as a person would look at the flat side of an apple cut in halves. "A" is the bowl of the separator supported by a spindle

"E" which is set in motion by a pulley "K" in which a belt, driven by steam or horse power, runs. The bowl is supported upon two narrow steel points at "w" which reduces the friction to a minimum. "B" is the iron support for the machine. "S" and "N" are oil cups. The milk is delivered through the tube "b" and flows into a little bowl "d" from which it passes out into the large bowl "A" through an opening not shown in the cut. "C" and "D" are tin pans made to fit closely down over the separator bowl. "v" is the speed indicator for determining the number of revolutions per minute. After the machine has been started and attained a speed of over 6,000 revolutions per minute, the milk is let into the bowl through the cock "b" and assumes the position in the bowl in layers arranged according to specific gravity. If there be any sand or dirt in the milk, this will be held near the outside or the bowl; then comes the layers of skim-milk, and lastly, next to the center of the bowl, comes the layer of the cream. At this rate of speed, the separation of the milk after it passes from the bowl "d" is almost instantaneous. The skim-milk is forced by the centrifugal force through the tube "e" and out through an opening in the side of it at "c" where the skim-milk is caught in the pan "D" and delivered through the lower spout. The cream rises upon the inside of the bowl, and passes out through a little slit in the top of it at "f" into the cream pan "C" and the cream is delivered from the upper spout. The quantity of skim-milk thrown off may be regulated by a little screw in the bowl at "f" which opens and closes the aperture at "c." This machine works very perfectly and leaves little to be desired so far as the quality of the work is concerned. Several modifications of the principle of this machine have been introduced, but they refer principally to the method of supplying the power. This particular form of machine is sold by the *De Laval Separator Co.*, 74 Cortlandt st., New York City, or by any of their agents throughout the country. P. M. Sharpless, of West Chester, Pa., manufactures what he terms an "*Improved De Laval*," which is meeting with extensive sale in the country. The latter manufactures a steam turbine separator in which the power is applied by steam acting upon a small turbine wheel at the bottom of the separator stand. I have not seen the machine in operation and hence cannot state positively as to the efficiency of this form of application of power to it. The success of the separator depends largely upon having an unvarying source of power, and if left to the direct action of steam, it will be necessary for the steam pressure in the boiler to be maintained uniform to secure the highest efficiency unless some automatic arrangement is devised for regulating the flow of milk to the separator.

Hand Separators.

The DeLaval Company manufactures two forms of hand machines adapted to use of small dairymen: one an upright form and the other horizontal. The horizontal machine is represented in the above cut. Our experience with the upright machine has

Fig. 2.



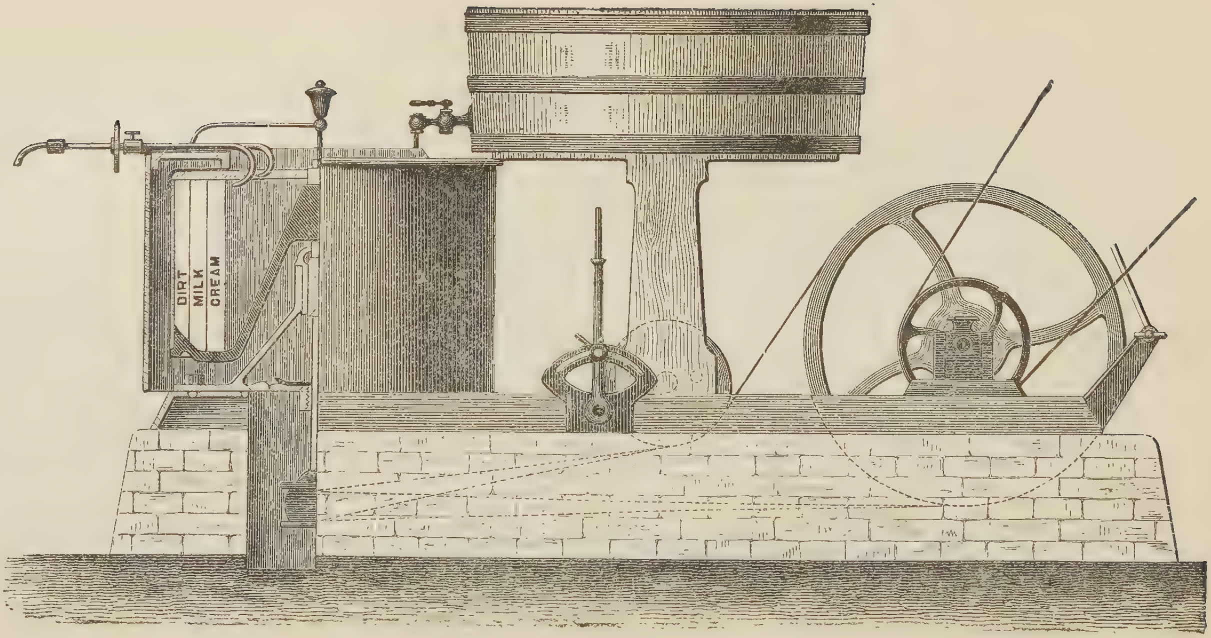
HORIZONTAL DELEVAL SEPARATOR.

been that it separates the cream satisfactorily; but the labor of turning the machine is very severe. The horizontal machine runs easier, and is said to do its work fully as satisfactorily. These hand machines will separate about 250 pounds of milk an hour.

The Danish Weston Separators.

The other machine prominently before the people is the "Danish Weston," a cut of which is herewith presented. The bowl of this machine is larger than that of the *DeLaval* and hence does not have to be run at such high speed. A study of the cut will show the manner in which the milk is separated in the bowl by centrifugal force. The cream stands next to the inside of the bowl and dirt next to the outside; while the skim-milk stands between the dirt and the cream. The cream is skimmed off by means of a tube set to catch it. As it rises in the cylinder, another tube is arranged so that it will catch the skim-milk and carry it off in another direction. These are provided with adjustments so that the quantity of milk taken with the cream can be changed to suit the wishes of the creamery-man at will. The "Danish Weston" will separate slightly sour milk. The "*DeLaval*" separator very soon becomes clogged when sour milk is run into it, and for this reason, some creameries prefer the "Danish Weston" machine; especially in sections where it is difficult or impossible to collect all of the milk at the creamery before it has begun to sour. This machine is, however considerably more expensive than the "*DeLaval*," and skims no closer. It rests with the Creamery Company to determine which kind of machine is best adapted to its use. The Greenbrier Creamery in this State uses the "Danish Weston" machine and I understand is very highly pleased with it. Most of the other creameries of the State use the "*DeLaval*" or the "Sharpless Improved *DeLaval.*" The "Danish Weston" machine can be secured through the Creamery Package Manufacturing Company, 20 North Clark street, Chicago, or from A. H. Ried, Philadelphia. It can also be had through almost any of the dealers in creamery supplies.

There is but one other separator manufactured in this country so far as known to us that requires our attention, and that is the "Backstrom," which is a most excellent machine, and in some respects I believe it superior to either of the machines named. We have had one of these machines at the station here, and have been well pleased with it. The machine has a shelf in the bowl upon which the skim-milk is forced by centrifugal force, and it is there caught by a tube similar to the arrangement in the "Danish Weston." The cream passes out through an opening at the bottom of the bowl, and is delivered at the side of the stand. In size and capacity, the machine is not unlike the *DeLaval.* At present, however, the Backstrom Manufacturing Company of New York, which owns the patent, seems to be financially embarrassed, and I believe there are none of the machines upon the market; a matter, I think, that is to be regretted, as it was the cheapest machine offered in the American market, and in our judgement one of the best.

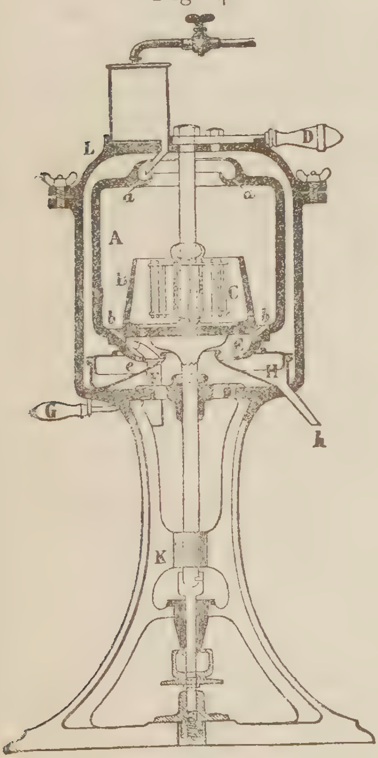


THE DANISH-WESTON SEPARATOR.

Recently, still another advance has been made in the separation of cream, and it is now proposed to extract the butter from the milk by means of centrifugal force. The chief difference between butter and cream is that the cream consists of the butter in a very finely divided condition held in suspension in a certain amount of liquid. The process of churning as ordinarily practiced causes the globules of fat in the cream to unite and form larger masses, so that most of the liquid can be drained off from them. Granulation of butter is nothing more than the aggregation of the small fat globules in the cream. Formerly it was supposed that in order to accomplish this, it was necessary to have the cream undergo a slight fermentation and become acid. The work at this Station during the past year indicates that this supposition is entirely without foundation, and by employing the proper means, we can secure as excellent a yield and as good quality of butter from sweet cream as from acid cream.

The butter extractor, which represents the farthest advance in the manufacture of butter by machinery, is the invention of C. A. Johansson of Stockholm, Sweden. Few of the machines have yet been placed upon the market in this country, and no doubt many improvements will be effected in it within the next few years; but the principle represents the highest advance in the handling of milk.

Fig. 4



A section of the machine is represented in the cut before us. It will be noticed that it is supported on a stand not very dissimilar from the stand of an ordinary separator; the machine being a little larger than the *DeLaval* separator. The machine is driven by a belt similar to the separator, by which the cylinder "A" is made to revolve at a speed of about 6,000 revolutions per minute. The internal construction of the cylinder is somewhat different from that of the separator. It will be noticed that it has an inside cylinder "B" which rises to about one-half the height of the larger cylinder. In the inside of this cylinder, is a trundle wheel "C" which also revolves with the machine, though at a less rate of speed. The machine is started, and after it attains the required speed, the milk is delivered through the small openings "aa" in the top, which throw the milk to the outside of the cylinder. This acting upon the principle of the cream separator causes the skim-milk to separate from the

cream and the skim-milk passes down through the openings "bb" and escapes through the opening "H." The cream drops into the inner cylinder "B" and is agitated by the trundle wheel "C;" the centrifugal force acting upon it causes the remainder of the liquid in the cream to take the outside of the cylinder, and it escapes through the small openings "bb" into the skim-milk, while the butter fat in a granulated condition drops through the openings into the chamber "E" where it is scooped up and carried off by the tube "F," a small portion of the skim-milk being allowed to accompany it so that it will move freely. The machine can be converted into a separator by withdrawing the trundle wheel; in which case, cream will be delivered through the tube "F" and the skim-milk through the tube "H."

The capacity of the machine is about 1,500 pounds of milk per hour. The milk may be either sweet or sour. It may be run as a separator and the cream kept until next day, and then as acid cream run through the extractor when acid cream butter is secured, or if sweet cream butter is preferred, one continuous operation does the work. Recent improvements in the machine provide an Automatic Feed Regulator, an Automatic Coloring Cup, and proper facilities for adjusting the quantity of color and the flow of the milk.

Observations upon Separation of Cream for November, 1889.

The following series of observations upon the separation of cream and churning were made before the butter extractor had been developed to its present stage of perfection. We are not yet sure that the butter extractor can be successfully used in this latitude without the expense of considerable ice, and we believe that the separator, for many years to come, will be the machine best adapted to the use of creameries in this latitude and countries farther south. In pursuing the series of observations which we herewith publish, we have endeavored, so far as our time and facilities would permit, to determine the conditions under which we could handle milk most economically and effectually, and also to determine the best methods of churning cream. At the end of each table of observations is given a summary indicating the most prominent points brought out by our observations. It was our expectation to continue the work, but circumstances over which we have had no control have forced us for the time being to discontinue the work, which we hope at some future time to take up and investigate a number of questions which this series of observations have raised in our own minds, and which may occur to other investigators upon studying our work. We publish it in the present form, however, without reservation, as we are still uncertain whether we shall be able to continue it.

	1	2	4	5	6	7	8	9	11	12	13	14
Pounds of milk handled	509	529	640	448	452	444	455	421	644	448	468	446
Av'rage fat contents (per ct.)	4.250	4.105	4.425	4.318	4.210	3.956	4.124	4.081	3.953	4.016	4.020	4.02[illegible]
Pounds cream obtained	100	109	130	90	92	90	92	85	125	90	93	89
Specific gravity of cream	....	....	....	....	....	....	....	....	....	....	....	....
Pounds of skim milk obt'ned	409	419½	510	358	360	354	362	336½	519	358	374	357
Specific gravity of skim milk	....	....	....	....	....	....	....	....	....	....	....	....
Fat content of skim milk	....	....	....	....	....	....	....	....	....	....	....	....
Temp. milk during separ't'n	80	81	80	80	80	82	80	80	80	81	75	80
Temp. of cream from sepa'tor	76	77	76½	76	76	79	76	76	76	77½	72	76
Temp. skim mk from sepe'tor	80	81	80	80	81	82	80	80	80	81	75	80
Speed of separator	6500	6500	6500	6500	6500	6500	6000	6000	6000	6500	6500	6500
Time of separation	35	36	38	31	30	30	31	30	38	32	32	30
Rate of sepa'ton pr hour in lbs.	872.5	884.7	1010.5	867 1	904.0	888 0	880.6	842 0	1016 8	840 0	877.5	892.0

15	16	18	19	20	21	22	23	25	26	27	29	30
484	463	798	489	457	473	451	418	932	417	446	905	325
3.855	4.212	4.149	4.186	3 991	4.059	4.067	4.055	3.947	4.064	4 070	3 968	4.311
98	92	72½	100	82	79	84	70	163½	67	80	170	63½
....	....	....	......	1.0000	1.0060	1.0060	....	1.0034	1.0090	1.0066	1.0135	1.0079
386	371	726	889	368	394	370	348	768	349	330	734	261
....	....	....	1.0357	1.0345	1·0360	1.0360	....	1.0340	1.0353	1.0353	1.0344	1.0368
....	....	....	....	....	....	....	....	....	....	....	....	....
78	80	80	84	84	86	84	84	82	85	84	86	84
75	76	76	80	79	82	80	80	79	81	80	81	80
78	80	80	84	81	86	84	84	82	85	84	84	84
6500	6500	6500	6500	7500	7500	7000	7000	7500	7500	7500	7500	7500
34	32	42	34	29½	31	28½	24	54	23½	24	60	20
854.1	868 1	1140 0	862 9	917.2	913 4	949. 4	1045 0	1035 5	1064 6	1365 0	905.0	975.00

Average of Observations Upon the Separation of Cream for the Month of November, 1889.

Average per cent. of butter fat in the milk, 4.097.

Average per cent. butter fat remaining in skim milk less than .1 of 1 per cent. (Our methods did not read closer than one-tenth per cent.).

Average quantity of milk handled per day, 511 pounds.

Average quantity of cream separated from the same, 96½ pounds.

Average per cent. of whole milk separated as cream, 18.88.

Average specific gravity of cream, 1.0065.

Average specific gravity of skim milk, 1.0352.

Average temperature of milk entering separator, 81.6 degrees.

Average temperature of cream coming from separator, 77.7.

Average temperature of skim milk coming from separator, 81.6.

The cream was cooled by the process of separation 3.9 degrees.

Average speed of separator, 6760.

Average time of separation, 33.18 minutes.

Average rate of separation per hour, 946.93 pounds.

It will be observed that the separator works perfectly at this rate of speed when the milk is at this temperature and delivered at the rate of about 950 pounds per hour. Where the percentage of fat found in skim milk was less than .1 of 1 per cent., it was marked a trace or as 0. Most of the determinations of the fat of skim milk made by the gravimetric method indicated from .02 per cent. to .05 per cent., and in some cases as high as .07 of 1 per cent., which all will recognize as being within the limits of error in chemical analysis.

Observations upon Separation of Cream for December, 1889.

	2	4	6	9	11	13
Pounds of milk handled	1006	1176	1121	1136	1125	1112
Average Fat content (per cent)	4.093	3 848	4.042	4.021	3.818	3.879
Pounds of Cream obtained	177	236	271	166	207	230½
Specific gravity of cream	1.0080	1.0117	1.0070	....	1.0110	1.0118
Pounds of skim milk obtained	828½	940	849¼	961	977	881
Specific gravity of skim milk	1 0353	1.0351	1.0370	....	1.0356	1.0355
Fat content of skim milk	.0	.0	.0	.0	.0	.0
Temperature of milk during separation	84	82	82	82	82	81
Temperature of cream from separator	80	78	78	78	78	77
T'mperat'e of skim milk from separator	84	82	81	82	82	81
Speed of separator	6500	6500	6500	6500	6500	6500
Time of separation	68	75	83	59	79	86
Rate of separation per hour	887.7	940 8	809.6	1155 2	854.4	776.7

	16	18	20	23	24	26	28	30
Pounds of milk handled	1323	1045	963	1282	518	949	1019	1135
Average Fat content (per cent)	3 838	3.807	3.787	3.624	3 889	3.734	No test	3,695
Pounds of Cream obtained	204	....	196½	202	87	139	192	208
Specific gravity of cream	1.0000	1.0148	1.0101	1.0090	1.0115	1,0000	1.0111	1,0121
Pounds of skim milk obtained	1118	....	767	1080	431	809	827	927
Specific gravity of skim milk	1.0352	1.0351	1 0354	1.0349	1.0351	1 0351	....	1.0350
Fat content of skim milk	.0	.0	.0	.0	.0	.0	.0	.0
Temperature of milk during separation	80	....	80	80	80	80	78	80
Temperature of cream from separator	76	....	76	76	76	78	75	76
T'mperat'e of skim milk from separator	80	....	80	80	80	80	78	80
Speed of separator	6500	....	6500	6500	6500	6500	6500	6000
Time of separation	95	....	65	90	38	61	72	85
Rate of separation per hour	835.5	....	888.9	854 6	817.8	933.4	849.1	801.7

Average of Observations upon the Separation of Cream for the Month of December, 1889.

Average quantity of milk handled per day, 938.8 pounds.

Average per cent. of butter fat in the milk, 3.855, making a decrease of butter fat content of the milk of December over that of November of .242.

Average per cent. of milk separated as cream, 19.80.

Average specific gravity of cream separated, 1.0090.

Average specific gravity of skim-milk, 1.0353.

Average temperature of milk entering separator, 80.84 degrees.

Average temperature of cream leaving separator, 77.07 degrees

Average temperature of skim-milk leaving separator, 80.84 degrees.

The cream during the process of separation being cooled, 3.77 degrees, against 3.90 degrees for November,

Average speed of separator per minute, 6461.

Average rate per hour at which milk was separated, 877.3.

Average fat content of skim-milk less than .1 of 1 per cent.

It will be observed that at this rate of separation, the speed of the separator being approximately 6500, and the temperature of the milk being approximately 80 & 1-2 degrees, the separation is completed to within the limits of error of chemical analysis. For this month, upon the average, about 1 per cent. more of skim-milk was taken out with the cream than for the month of November.

Observations upon Separation of Cream for January, 1890.

	1	3	6	8	10	13	15	17	20	22	24	27	29	31
Pounds of milk handled	954	1097	1437	1103	1090	1232	1088	1035	1507	1087	1092	1453	977	1062
Average fat content (per cent.)	No test	4 418	4.444	5 220	4 377	4.450	4.345	4 511	4.644	4.628	4.575	3 444	3 675	No test
Pounds of cream obtained	167	183	218	176	177	165	184	172½	236	296	205	290½	180	174
Pounds of skim milk obtained	787	9.4	1218	927	915	1067	904	863	1271	791	887	1163	797	886
Fat content of skim milk		.0	.0	.1	.1	.0	Trace	.0	.0	.0	.1	Trace	0	.2
Temperature of milk during separation	80	80	81	81	80	75	80	80	80	80	80	80	81	81
Temperature of cream from separator	76	76	76½	77½	77	73	76	78	76	76	77	77	79	79
Temperature of skim milk from sep'tor	80	80	80	80	80½	75½	80	81	80	80	81	80	81	81
Speed of separator	6000	6500	6500	6500	6500	7000	7000	6500	6500	6500	6500	6500	6500	6000
Time of separation	75	65	85	65	63	60	65	70	85	60	74	87	60	60
Rate of separation per hour	763.2	1012.6	1014.3	1018.1	1038.0	1232.0	1043.	887 1	1063.7	987.0	885.4	1002.0	977.0	1062.0

Average Observations upon the Separation of Cream for the Month of January, 1890.

Average quantity of milk handled per day, 1158 pounds.

Average per cent. of butter fat in milk, 4.394, being an increase in butter fat of .539 over that of December, and an increase of 0.297 over that of November.

Average per cent. of milk separated as cream, 16.97.

Average temperature of milk entering separator, 79.9 degrees.

Average temperature of cream delivered from separator, 76.7 degrees.

Average cooling of cream during separation, 3.2 degrees.

Average speed of separator 6500.

The average observations for the three months, November, December and January, indicate that the cream coming from the separator is cooled during the process of separation from 3.2 degrees to 3.9 degrees, having an average of 3.62 degrees. The skim-milk delivered from the separator has uniformly the same temperature as the milk entering the separator. The energy of separation is therefore expended upon the cream, which is converted into mist, giving it perfect aeration and depriving it during the process of separation of animal heat and animal odors contained in it, and its chemical composition is sufficiently changed to render it unadapted to the manufacture of the best quality of whipped cream without the use of some substance, like the white of an egg, to increase its adhesive powers.

The cream coming from the separator is undoubtedly the purest form of cream offered to the public, being deprived of its impurities and all foul odors that may have been absorbed by it.

It will be noticed that the separation for the month of January was not so perfect as during the two preceding months. The skim milk contained on several occasions as much as .1 of 1 per cent. and on one day as much as .2 of 1 per cent.

The rate of separation of the milk was 998.9 pounds per hour. The extreme variation maximum from this makes 1232 pounds per hour. Minimum 763.2 pounds per hour.

It would seem from the observations of this month that separation of milk is not perfect at revolutions of the separator below 6000 when the rate of delivery of milk is over 1000 pounds per hour. It would seem that the capacity of the machine had been reached, or at least that if the milk be fed to the machine rapidly at the rate of 1000 pounds per hour, there is likely to be a small residue of butter fat left in the skim milk, and yet, with the machine going at 7000 revolutions per minute, we succeeded in separating perfectly at the rate of 1232 pounds per hour. In one case where the machine was running at 7000 revolutions per minute, there was a small residue of butter fat in the skim milk when we were separating at the rate of 1043 pounds per hour. Our machine is rated at 850 pounds of milk per hour; but we have uniformly run it at a higher rate.

Observations upon Separation of Cream for February, 1890.

	3	5	7	10	12	14	17	19	21	24	26	28
Pounds of milk received	1336	983	979	1197	967	927	1231	913	623	1463	877	893
Temperature of milk separated	80	78	81	80	80	82	81	84	82	82	81	82
Temperature of cream out	76	76	78	76	76	79	79	81	80	80½	80	82
Temperature of skim milk out	80	78	81	80	80	82	82	84	83	83	82	84
Pounds of cream separated	245	192	183½	212	140	133½	170	148	120½	249	161½	147
Pounds of skim milk separated	1091	791	795	985	727	793	1061	764	502	1214	715	746
Loss in handling	.0	.0	.5	.0	.0	.5	.0	.1	.5	.0	.5	.0
Minutes separating	80	63	71	70	54	52	65	51	35	80	60	50
Condition of machinery	O. K.	O. K.	O. K.	O. K.	O. K.	O. K.	O. K.	O. K.	O. K.	O. K.	Off.	O. K.
Speed of separator	6600	6500	6500	6000	6500	7000	7000	7000	7000	7000	6500	7000
Temperature of room	62	61	58	50	54	60	62	55	46	61	60	64
Rate of separation in pounds per hour	1002	936	827.3	1026	1074.4	1069.6	1136.3	1074.1	1068	1097.2	877	1071.6

Average of Observations upon the Separation of Cream for the Month of February, 1890.

Average quantity of milk handled, 1032.4 pounds.

Average per cent. of the whole milk separated as cream 16.96.

Average temperature of milk at time of separation, 81 degrees.

Average speed of separator, 6716.

Average temperature of cream delivered from separator, 78.6 degrees.

Average time of separation, 60.9 minutes.

Average reduction of temperature of cream during process of separation, 2.4 degrees.

Average rate of separation per hour, 1021.6.

The speed of the separator this month ranged from 6500 to 7000 per minute.

During this month, the tests of the skim-milk showed in all cases less than .1 of 1 per cent. of butter fat in the skim-milk, and the observations are accordingly neglected in the table. Another line of observations was begun indicating the quantity lost in handling. It will be observed that on four days of the month, the loss amounted to .5 pounds. On 7 days there was no loss, and 1 day, there was a loss of .1 pound. This loss occurs principally in leakage around the lids of the separator or in the conveying pipes, and is scarcely appreciable. The observations upon the loss of milk in this case indicate simply that the Creamery-man was working with great care, as the variation in any two weighings might be nearly as large as that recorded; but when the averages were taken for the different weighings during the day, the loss in handling to be accounted for was indicated by the figures given. It is apparent, therefore, that the loss in handling milk is this way in inappreciable.

Observations upon Separation of Cream for March, 1890.

	3	5	7	10	12
Pounds of milk received	1210	845	968	1222	920
Temperature of milk separated	80	80½	82	82	80
Temperature of cream out	77	77	80	78	79
Temperature of skim milk out	81	80	82	83	82
Pounds of cream separated	221	149	170	216	144
Pounds of skim milk separated	989	696	798	1004	776
Loss in handling	....	....	....	2	....
Minutes separating	65	51	50	80	45
Condition of machinery	Off	O K	O K	O K	O K
Speed of separator	6500	7000	6500	7000	6000
Rate of separation per hour. Pounds	1116.9	994·1	1161.6	916.5	1226.6

	14	17	19	21	24	26	28	31
Pounds of milk received	846	1260	986	1011	1310	1030	1125	1418
Temperature of milk separated	82	80	82	82	82	80	80	80
Temperature of cream out	80	76	80	80	80	78	78	78
Temperature of skim milk out	83	80	82	83	82	80	81	82
Pounds of cream separated	151	238	194	165	246	189½	209	262
Pounds of skim milk separated	695	1022	791	846	1064	841	916	1156
Loss in handling	....	....	1	....	....	½	....	....
Minutes separating	45	82	55	65	72	55	62	77
Condition of machinery	O K	O K	O K	O K	O K	O K	O K	O K
Speed of separator	7000	7000	6500	6500	6500	7000	6500	6500
Rate of separation per hour. Pounds	1128	921.9	1075.6	933.2	1091.6	1123.6	1088.7	1104.9

Average of Observations upon the Separation of Cream for the Month of March 1890,

Average quantity of milk handled per day, 1088 pounds.
Average temperature of milk entering the separator, 80.9 degrees.
Average temperature of cream coming from the separator, 78.5.
Average reduction ot temperature of cream by separation, 2.4.
Average time of separation, 61.81 minutes.
Average speed of separator, 6653.
Average rate of separation per hour, 1067.9 pounds.
Average quantity of cream separated, 196.5 pounds.
Average per cent of whole milk separated as cream, 18.6.

The skim-milk for this month showed no appreciable residue of butter fat upon the days it was tested. It is probable, however, that a larger per cent of butter fat was left in the skim-milk during this month than during the previous months when we were testing the skim-milk more closely. The loss in handling the milk, it will be seen, is scarcely appreciable. The machinery ran regularly except the first day of separation, when some difficulty appears to have arisen; the term "off" in the table being used to indicate that some slight trouble interfered for a time with the working of the machinery, such as the slipping of belts, irregularity in the working of the engine, or some trifling matter of that character. It is not to be supposed that a speed of 6500 or 7000 was maintained uniformly throughout the whole time of separation, as it is almost impossible to keep the engine running with sufficient regularity to hold the speed for an hour at this figure; but the Creamery-man, as the speed varies, must adjust the flow of milk to the separator to suit the speed. A man in the habit of directing his attention to the condition of the machinery during the process of separation will notice slight variations in the speed even without the aid of a speedometer.

Observations upon Separation of Cream for April, 1890.

	2	4	7	9	11	14	16	18	21	23	25	26	28	29	30
Pounds of milk received	1091	1189	1352	974	1202	1501	1388	1432	1803	1712	1509	866	1594	1112	1056
Temperature of milk separated	82	80	80	88	82	84	80	80	83	76	78	78	80	76	78
Temperature of cream out	78	78	80	86	79	82	78	78	80	74	76	76	78	75	76
Temperature of skim milk out	82	80	82	88	82	84	80	80	83	76	78	78	80	77	78
Pounds of cream separated	185	217	233	151	191	287	200	263	321	275	258	151	274	204	160
Pounds of skim milk separated	905	972	1119	822	1011	1210	1186	1168	1581	1436	1249	755	1318	908	896
Loss in handling	1	0	0	1	0	4	2	1	1	1	2	0	2	0	0
Minutes separating	63	67½	72	51	66	77	80	60	85	75	80	42	83	58	52
Condition of machinery	O K	O K	O K	O K	O K	......	O K	O K	O K	O K	O K	O K	O K	O K	O K
Speed of separator	6500	6500	6500	6500	6500	6500	6000	7000	6500	6500	6500	6500	6000	6500	6500
Rate of separator per 100 pounds	1039	1056.8	1126.6	1146	1092.7	1169 6	1041	1432	1272.7	1369.6	1131.7	1237.1	1152.2	1150.3	1218.4

Average of Observations upon the Separation of Cream for the Month of April, 1890.

Average quantity of milk handled per day, 1319.3 pounds.

Average temperature of milk delivered to the separator, 80.3 degrees.

Average temperature of cream delivered from separator, 78.2 degrees.

Average reduction of temperature during process of separation, 2.1 degrees.

Average quantity of cream separated, 224.6 pounds.

Average per cent. of whole milk separated as cream, 17.2.

Average time of separation, 67.4 minutes.

Average speed of separator, 6406.

Average rate of separation per hour, 1175 pounds.

The tests of skim-milk during this month indicate that a small percentage of butter fat, still less, however, than .1 of 1 per cent. upon the average, remains in the skim-milk. The tests were not made daily, however, and the observations for that reason are not recorded in the tables published. It will be noticed that the wastage of milk in handling has increased to a certain extent; but still upon the average, it would make a very small fraction of 19790 pounds of milk handled during this month; the whole loss in handling the entire quantity being only 15 pounds.

The observations upon the separation of milk as practiced in this creamery for the period extending from November 1st, 1889, to May 1st, 1890, indicate that the best results are secured under the following conditions: The milk should have a temperature of from 80 to 82 degrees. The separator to run at a speed of from 6500 to 7000 revolutions per minute. The engine should be maintained at a constant rate of speed. The delivery of the milk should be uniform, and at a rate of 900 pounds per hour. About 18 per cent. of the whole milk should be separated as cream. We separated as cream from this period an average of 17.97 per cent. of the whole milk. It is doubtful whether the percentage of fat in the skim-milk is reduced by running 20 per cent. of the whole milk through the cream pan of the separator.

Observations upon Churning for November, 1889.

	2	3	4	5	6	7	8	9	11	12	14	14	14
Pounds of cream churned	100	86	76	61	60				86	128			
Specific gravity of cream (observations under this head were not made until the 20th)													
Condition of cream churned	24 hrs. Acid	48 hrs. Acid.	Sweet.	Sweet.	Sweet.		hrs. 24 Acid.	hrs. 24 Acid.	hrs. 48 Acid.	hrs. 24 Acid.	hrs. 48 Acid.	hrs. 24 Acid.	Sweet.
Theoretical butter value	21.63	21.71	28.32	19.34	19.02		18.76	17.18	25.45	17.99	18.81	17.97	18.65
Actual yield of unworked butter	28	22	29	24	23		23½	18	31	34	25	24	18
Number lbs. of marketable butter	26	19	24	21	19		20½	13	25	31	20	22	15
Temperature of cream at starting	60	60	60	60	60		60	62	60	60	60	60	60
Temperature of cream at ending	62	62	62	62	62		62	64	62	62	62	62	62
Minutes required in churning	25	20	8	8½	18		15	15	18	20	19	20	12
Speed of churn	40	40	40	40	45		40	48	45	45	40	40	40
Pounds of water or ice used	0	0	0	0	0		0	0	0	0	0	0	0
Pounds of buttermilk obtained (observations not recorded until the 18th)													
Fat content of buttermilk							1.543	1.543	.0	.0	2.053	2.563	.0
Ounces of salt per pound of butter	1¼	1¼	1¼	Brine.	1¼		1¼	1¼	1¼	1¼	1¼	1¼	1¼
Number Drams of coloring used	10	8	7½	4½	8		10	7½	9	12	9	9½	6
Pounds of water worked out of butter (observations not recorded until the 18th)													
Pounds of cream after second separation			12	14	6								
Specific gravity of cream after 2d separation													
Butter from cream after 2nd separation	Acid B. M.	Acid B. M.	4	3½	Oz. 12		Acid B M.	Acid B. M.	Acid B. M.	Acid B. M.	Acid B. M.	Acid B. M.	8¼oz

Observations upon Churning for November, 1889—Continued

	18	19	19	20	21	22	23	25	27	27	29	30
Pounds of cream churned	72½	180	100	82	77	84	70	163	81	80	165	53
Specific gravity of cream (observations under this head were not made until the 20th	....	....	....	1.0000	1.0060	1.0060	....	1.0340	1.0355	1.0353	1.0344	1 0368
Condition of cream churned	hrs. 48 Acid.	hrs. 22 Acid.	Sweet.	Sweet.	Sweet.	Sweet.	Sweet.	Sweet.	hrs. 24 Acid.	Sweet	Sweet.	Sweet.
Theoretical butter value	19 50	33.10	20.46	17.99	19.19	18.34	15.44	36.78	16.94	22 22	35.91	14.01
Actual yield of unworked butter	26	46	23	27	22	22	29	52	32	30	63	13
Number lbs. of marketable butter	25	43	21	21	19¾	23	24	47	24	23	44	10-8 oz.
Temperature of cream at starting	58	60	64	64	61	59	57	56	58	59	50	53
Temperature of cream at ending	60	62	64	64	62	60	59	59	58	56	55	58
Minutes required in churning	27½	14	8	12	7½	7	11	9½	17	8	30	15
Speed of churn	45	35	35	35	37	40	35	40	40	40	40	40
Pounds of water or ice used	14	24	4½	2	30	5	4	20	10	0	30	20
Pounds of buttermilk obtained (observations not recorded until the 18th)	51	139	80½	55	58	60	49	122	59	57	138	36
Fat content of buttermilk	.0	1.747	.0	....	....	2.359	1.645	2.563	.0	3.481	Trace.	.0
Ounces of salt per pound of butter	1	½	½	1	1	1	1	1½	1¼	1¼	1¼	1¼
Number drams of coloring used	9	16	9½	10	9½	11	11	22	10½	10¼	22	7
Pounds of water worked out of butter (observations not recorded until the 18th)	Oz. 3-6½	....	Oz. 2-8	Oz. 4-2	Oz. 3-3	....	11	Oz. 11-8	Oz 8-7	Oz. 6-3	Oz. 12-6	Oz. 4-8
Pounds of cream after second separation	....	....	*	....	....	....	....	....	....	....	....	....
Specific gravity of cream after second separation	....	....	1 0023	....	....	....	....	1.0167	....	....	....	....
Butter from cream after 2nd separation	Acid B. M.	Acid B. M.	Oz. 6-3	5	2	Oz. 1-8	0	4	Acid B. M.	Oz 1-4	0	8

*Cream from the second separation varied greatly as to its butter value, due to more or less milk necessarily introduced to start the flow of cream from the separator; hence the amount was not recorded, the object being to secure all of the butter fat.

Summary of Observations Upon Churning for November, 1889.

The churn used for this work was a 200 gallon Blanchard Rectangular churn, provided with a glass window for examining the cream during the process of churning, with an air valve for allowing the air or gas to escape.

In the churning of sweet cream, our method has been to take the cream that comes from the separator, cool as quickly as possible to the proper temperature, pour into the churn, and proceed with the churning without delay. The churning was done at from 35 to 48 revolutions per minute, average about 40. As soon as the butter assumed a granulated condition, the churn was stopped, the sweet buttermilk drained off and warmed to about 80 degrees and run through the separator. The cream secured from the second separation for experimental purposes, was churned separately; though in ordinary practice it can be churned with the cream secured from the separation of the next day. The butter secured in this form is in a perfectly granulated condition, may be washed and treated just as ordinary acid cream butter, with the exception that more salt is required for the sweet cream than for the acid cream butter. In the process of working the butter, the salt does not seem to be taken up by the sweet as readily as by the acid cream butter, and an additional quantity appears to be necessary to give the butter the customary degree of saltiness.

That this process of handling butter is expeditious may be illustrated by the fact that milk drawn from the cows in the morning and delivered at the creamery by eight or half past eight o'clock, was manufactured and printed into butter of the quality used upon the President's private table, and shipped before eleven o'clock of the same day.

The following figures for the month of November indicate what has been done

Total butter-fat contained in the quantity of cream churned, as acid cream, 229.04.

Marketable butter secured from above amount of acid cream, 268.5.

An increase of total yield over test yield of, 39.40 pounds.

Per cent. of increased yield over test yield, 17.2.

Total quantity of butter-fat contained in cream churned as sweet cream, 285.67 pounds.

Marketable butter secured from the cream obtained by the first separation, 312.37 pounds.

Marketable butter secured from the cream derived from the second separation, 36.70.

Total marketable butter from sweet cream, 349.07.

Increase of actual marketable sweet cream butter over test yield, 63.40 pounds.

Per cent. of increase of yield of marketable butter over test yield, 22.1.

Average in yield in favor of churning sweet cream, 4.9 per cent.

Average time required to churn acid cream, 19.1 minute.

Average time required to churn sweet cream, 11.9 minutes.

Sweet cream was churned on the average of 7.2 minutes more quickly than acid cream.

Acid butter-milk at the end of churning varied in temperature from 58 to 64 degrees.

Sweet butter-milk at the end of churning varied in temperature from 55 to 62 degrees. Where there is little or no rise of temperature in the cream during churning of sweet cream, the residual fat in the butter-milk appears to be larger in some cases than where considerable rise of temperature is apparent.

Observations upon Churning for December, 1889.

	2	4	6	9	11	13	16	19	20	23	24	26	28	30
Pounds of cream churned	177	236	271	166	198	205	204	245	139	202	87	1.8	172	207
Specific gravity of cream	1.0353	1 0351	1.0370	.....	1.0356	1.0355	1 0352	1.0357	1.0354	1.0349	1.0351	1 0357	.....	1.0350
Condition of cream churned	Sweet	Sweet	Sweet	Sweet	Sweet	Sweet	Sweet	hrs. 21 Acid	Sweet	Sweet	Sweet	Sweet	Sweet	Sweet
Theoretical butter value	41.17	5.25	45.31	15 67	42.95	13 13	51 04	39 78	36 46	46.45	20.14	35 7.	No. test	41 93
Actual yield of unworked butter	67	65	65½	16	58	59	81	58	58	72	27	42	55	56
Number pounds of marketable butter	50-6	51-2	55 12	36-10	49	50	57 8	50	44.14	52-10	22 8	32-8	45-9	44 13
Temperature of cream at starting	56	56	51	62	54	52	60	60	53	56	54	59	55	55
Temperature of cream at ending	59	58	57	62	57	55	63	61	58	55	58	60	57	58
Minutes required in churning	18½	29	24	10	24	30½	12	15	22	18	7½	8	19	20
Speed of churn	40	40	40	40	40	42	40	40	40	40	40	40	40	40
Pounds of water or ice used	0	34	56	0	0	0	37	0	0	0	1	0	10	0
Pounds of buttermilk obtained	129	203	206	120	140	143	127	190	89	127	60	81	139	137
Pounds of fat content of buttermilk	1.543	1.339	Trace	......	1.339	1.339	2.665	Trace	1.543	1.747	3 175	3 586	......	1.849
Ounces of salt per pound of butter	1¼	1⅜	1⅝	1⅜	1½	1½	1½	1½	1½	1⅝	1⅝	1¾	2	1½
Number of drams of coloring used	25	26	25	21	23	25	27	23	21	26	11	20	21	23
Pounds of water worked out of butter	18	10 8	8 8	8-10	10-8	11-12	23 4	12-8	15-12	20-08	7-4	16	13	10
Butter from cream from 2nd separation	0	0	oz. 14½	oz 8-8	0	oz 1-4	oz 3 15	oz 1 3½	oz. 1-11½	oz. 1-13	oz. 2-11½	oz. 6-13¾	oz. 3-6½	0
Per ct. of fat of buttermilk from cream from 2nd separation	1.543	1.339	Trace*	Trace	Trace	Trace	1.543	Trace	......	......	Trace	Trace	......	......

*By trace we mean less than 1-10 of one per cent but over .05 per cent.

Summary of Observations upon Churning Sweet Cream for December, 1889.

Total amount of cream churned, 2627 pounds.

The test value of the cream churned as sweet cream was 495.21, pounds.

Produced unworked butter, 751.5, pounds.

Marketable butter from first separation, 601.37, pounds.

Salt water worked out of butter in excess of salt added, 50.13.

Per cent. of increase of marketable butter over the butter fat contained in the cream from first separation, 21.4 pounds.

Marketable butter secured from second separation 32.32, pounds.

Added to that from first separation gives 633.69 pounds.

It required to make one pound of marketable butter 4.14 pounds of cream.

The total gain of marketable butter over test yield butter fat was therefore, 27.9 per cent.

We observe that in all cases in the churning of sweet cream, there is a rise of temperature in the cream during process of churning ranging from 1 to 3 degrees when churning is done at temperatures from 52 to 60 degrees. There appears to be no rise of temperature when churning at 62 degrees; but a very large proportion of the butter fat remained in the cream to be secured by the second separation. The best results in churning sweet cream this month were secured where the temperature of the cream arose about 3 degrees during the process of churning. In three cases, all butter being so fully secured that even the separator failed to extract any significant amount of butter fat from the sweet cream butter-milk. The demands of our customers require the use of from 1½ to 2 ounces of salt to a pound of unworked butter. The reason for this is not clear to us at present; but sweet cream butter having from 1½ to 2 ounces of salt added to it has about the same degree of saltiness as acid cream butter containing from 1 to 1½ ounces of salt.

Observations upon Churning for January, 1890.

	2	3	6	9	10	13	15	17	20	23	24	27	29	31
Pounds of cream churned	167	180	203	176	137	149	184	172½	236	195	187	206	180	176
Condition of cream churned	hrs. 21 Acid.	Sweet.	Sweet	hrs. 24 Acid.	Sweet.	Sweet	Sweet	Sweet.	Sweet.	hrs 24 Acid.	Sweet	Sweet	hrs. 24 Acid.	Sweet.
Test--butter-fat value	....	48 46	63 86	57 57	47.80	54.82	47 27	46.68	69.98	45 67	49 95	50.04	35 90	....
Actual yield of unworked butter	56	60	72	60	47½	44½	52½	58½	82	58	54	56	60	55
Number pounds of marketable butter	49	51	70	57	47	52	50	58	75	49	48	46	52	50
Temperature of cream at starting	58	50	54	62	42	45	58	42	52	53	54	56	62	49
Temperature of cream at ending	60	54	56	63	52	56	61	52	54	60	56	58	60	51
Minutes required in churning	24	22	19	16	37	18	30	45	24	52	19	20	12	17
Speed of churn	40	40	40	40	40	40	40	40	40	40	40	40	40	40
Pounds of water or ice used	20	25	80	....	34	24	....	39	40	16	15	25	12	39
Pounds of buttermilk obtained	88	94	107	120	94	93	127	111	150	133	113	151	105	116
Fat content of buttermilk	.4	.2	6	....	.0	2	.4	.0	.7	.3	.3	.2	....	.2
Ounces of salt per pound of butter	2	2	2	2	2	1¾	1½	1½	1½	1½	1½	1½	1½	1½
Number drams of coloring used	20	22	29	22	22	21	22	21	30	20	22	26	16	18½
Pounds of water worked out of butter after second separation	11-8	11-8	13	9-8	7-8	8	4-4	3 4	13-12	2-4	7-8	11	11-8	7-8
Specific gravity of cream after 2d separation	....	....	1.0283	....	....	....	....	....	....	....	....	....	....	....
Butter from cream after second separation	Acid B. M.	oz 8	oz 1-13	Acid. B. M.	.C	.0	oz. 1-1	.0	.0	Acid. B. M.	oz. 15½	lb. 1	Acid B. M.	oz 6
Per cent of fat of buttermilk from cream after second separation	.0	.0	....	....	.0	.0	Trace.	.0	.0	....	.0	.1	....	....

Summary of Observations upon Churning for January, 1890.

Total sweet cream churned, 1830.5 pounds.
Total acid cream churned, 718 pounds.
Test value of sweet cream churned, 478.86 pounds.
Test value of acid cream churned, 139.14 pounds.
Yield of unworked sweet cream butter, 527 pounds.
Yield of unworked acid cream butter, 178 pounds.
Marketable butter secured from sweet cream, 497 pounds.
Marketable butter secured from acid cream, 157 pounds.
Per cent of gain of marketable butter over test value of sweet cream butter, 4.9.
Per cent of gain of marketable butter over test value of acid cream, 13.5.
It required 3.68 pounds sweet cream to make one pound of butter,
It required 4.57 pounds of acid cream to make one pound of butter.
Average temperature of sweet cream at beginning of churning, 50.3 degrees.
Average temperature of sweet cream at ending of churning, 55.4 degrees.
Rise of temperature during churning of sweet cream, 5.1 degrees.
Average temperature of acid cream at beginning of churning, 59 degrees.
Average temperature of acid cream at end of churning, 61 degrees.
Average fat content of butter-milk from sweet cream 0.26 per cent.
Per cent of weight of unworked sweet cream butter worked out as salt water, 15.1.
Per cent of weight of acid cream butter worked out as salt water, 13.

Observations upon Churning of Sweet Cream for February, 1890.

	4	5	7	10	12	14	17	19	21	24	26	28
Temperature of cream	64	62	52	48	46	48	64	45	38	51	50	46
Hours after separation	24	0	0	0	0	0	0	0	0	0	0	0
Pounds of cream churned	242	192	165	169	110	133½	170	124	70	241	161	139
Pounds of water added	25	30	25	30	20	27	57	35	2	45	30	30
Temperature of water	Ice	Ice	Ice	Ice	Ice	Ice	45	Ice	Ice	Ice	Ice	Ice
Revolutions of churn per minute	40	40	40	40	40	40	40	40	40	40	40	40
Number of drams of coloring	24	18	16	16	12	16	8½	12	6	22	13	12
Ounces of salt per one pound of butter	1½	1¼	1½	1½	1½	1½	1½	1½	1½	1½	1½	1½
Minutes churning	9	13	22	33	18	16	21	29	43	27	22	15
Minutes draining butter milk	15	15	15	30	30	20	20	20	20	30	20	20
Minutes draining wash water	20	20	20	40	20	20	20	20	20	20	20	20
Pounds of butter milk	182	152	135	107	72½	164	118	95	47	158	117	95
Temperature of butter milk at end of churning	66	63	54	51	52	54	66	53	50	55	55	54
Pounds of butter before working	65	36½	57	50	39	52	55½	35¾	21	79½	44	40½
Pounds of butter after working	58	30¾	41¾	42¼	33½	42½	50½	36	18½	68½	42½	40½
Pounds of salt water worked out	11¼	7	10¾	7¼	6¼	12	9	2¼	3¼	14½	5	3
Temperature of worked butter	56	54	54	54	2	52	54	54	54	54	56	58
Pounds of cream from second separation	20	24	14	0	0	0	21	0	0	12	8	13
Pounds of butter from cream after second separation	lbs oz 2 9	lb oz 1 8	oz 7½	0	0	0	lbs. 6	0	0	oz 6	0	oz 14

Summary of Observations upon Churning of Sweet Cream for February, 1890.

Total cream churned, 1916.5 pounds.

Average time of churning, 22⅓ minutes.

Average temperature at beginning of churning, 51 degrees.

Average temperature at end of churning, 56 degrees.

Increase of temperature by churning, 5 degrees.

Unwashed butter secured, 575.75 pounds.

Marketable butter secured, 505.25 pounds.

Salt water worked out of butter, 91.75.

Salt water worked out is equal to 15.9 per cent. of the unworked butter before the addition of the salt.

It required 3.79 pounds of cream to make one pound of marketable butter.

It will be noticed that during this month, we churned at temperature as low as 45 degrees; but in no case was the churning completed at a temperature lower than 51 degrees. It will be further noted, that by churning at the low temperature below 50 degrees, substantially all of the butter can be secured from sweet cream without employing the second separation.

Observations Upon Churning for March, 1890.

	3	5	7	10	12	14	17	19	21	24	26	28	31
Temperature of cream	49	45	42	48	48	56	50	48	48	42	48	46	41¾
Hours after separation	0	0	0	0	0	0	0	0	0	0	0	0	0
Pounds of cream churned	218	149	160	216	128	138½	224½	179	156½	230	189½	204	270
Pounds of water added	35	30	35	40	30	25½	36	31	30	50	35	40	58
Temperature of water	Ice	Ice	Ice	Ice	Ice	Ice	Ice	Ice	Ice	Ice	Ice	Ice	Ice
Revolutions of churn per minute	40	40	40	40	40	40	40	40	40	40	40	40	40
Number of drams of coloring	18	12	12	19	12	12	18	12	15	18	15	16	20
Ounces of salt per 1 lb. of butter	1½	1½	1½	1½	1½	1½	1½	1½	1½	1½	1½	1½	1½
Minutes churning	29	33	63	45	28	50	37	57	25	80	20	30	100
Minutes draining butter milk	20	20	20	20	20	20	20	20	20	20	20	20	20
Minutes draining wash water	20	20	20	20	60	20	20	20	20	20	20	20	20
Pounds of buttermilk	147	97	109	142	87	90	160	134	107½	166	133	150	180
Temperature of butter at end of churning	54	53	54	54	54	52	56	54	54	52	52	52	53
Pounds of butter before working	62	45	49	70½	38½	37	63½	50½	46	61	52	57	71
Pounds of butter after working	56½	40½	43½	59	59	34	55½	43	44½	58¼	46	53	63
Pounds of water worked out of butter	9	8	4½	15	2½	3	9	9½	4½	6½	8½	9	11
Temperature of worked butter	48	50	50	52	56	54	52	52	56	50	52	52	50
Pounds of cream from second separation	10	0	....	....	....	....	....	....	....	....	....	....	....

Summary of Observations upon Churning for March, 1890.

Total amount of cream churned, 2460 pounds.

Average temperature at beginning of churning, 44.4 degrees.

Average temperature of butter-milk at the end of churning, 50.8 degrees.

Increase of temperature by churning, 6.4 degrees.

Average time of churning, 41 minutes.

Unworked butter obtained, 827.75 pounds.

Marketable butter secured, 783.75 pounds.

Salt water worked out, 86 pounds.

Per cent. of unworked butter passing off as salt water, 10.3 pounds.

Average temperature at which the butter was worked, 53.5 degrees.

Amount of cream necessary to produce one pound of marketable butter, 3.15 pounds.

By churning at the low temperature indicated, it was found that the butter could be very perfectly extracted from the sweet cream, and the process of a second separation was abandoned. Our Creamery-man stated that no appreciable amount of cream could be secured from the sweet cream butter milk by running it through the separator after churning at temperatures ranging from about 42 to 50 degrees. It will be noticed further, that we determined upon 1½ ounces of salt as the amount best adapted to the tastes of our customers.

Observations upon Churning for April, 1890.

	2	4	7	9	11	14	16	18	21	23	25	26	28	29	30
Temperature of cream at churning	48	46	46	48	42	42	38	42	42	50	46	40	46	43	47
Hours after separation	0	0	0	0	0	0	0	0	0	*0	0	‡0	0	0	0
Pounds of cream churned	181	214½	232½	139	190	274½	191½	217	241	274	217	59	257	180	136
Pounds of water added	35	48	47	30	41	52½	50	49	52½	47½	41	14	45	35	24
Temperature of water	Ice	Ice	Ice	I e	Ice	Ice	Ice	Ice	Ice	Ice	Ice	Ice	Ice	Ice	Ice
Revolutions of churn per minute	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40
Number of drams of coloring	16	17	20	15	16	20	16	16	15	20	16	5	16	10	8
Ounces of salt per one pound of butter	1½	1½	1½	1½	1½	1½	1½	1½	1½	1½	1½	1½	1½	1½	1½
Minutes churning	30	35	36	20	41	45	60	55	55	79	34	21	37	45	22
Minutes draining buttermilk	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
Minutes draining wash water	20	80	20	20	120	20	20	20	20	20	20	20	20	20	20
Pounds of buttermilk	124	154	165	169	126	207	124	160	176	383	150	61	187	132	105
Temperature of buttermilk at end of churning	52	53	50	56	48	48	46	52	48	57	51	46	52	50	53
Pounds of butter before working	51	56	63	39	57½	70	62	54¾	65	78	61½	20½	67	45	37½
Pounds of butter after working	49	55	60¼	40	53¾	61¼	60	52	62	70½	54	21½	64½	41	37½
Pounds of water worked out of butter	4	5½	6¼	3	5	10½	6	4	5½	6¾	11¼	¾	6¾	6¾	4
Temperature of worked butter	52	53	55	56	53	53	52	54	53	53	52½	56	54	50	50

*192 pounds of sour milk churned with cream of 23d.
‡24 pounds of sour cream mixed with churning.

Summary of Observations upon Churning for April, 1890.

Total sweet cream churned, 2671.

Rejecting the two days upon which acid cream was churned, we have average temperature at beginning of churning, 44.3 degrees

Average temperature at end of churning, 50.6 degrees.

Rise of temperature during churning, 6.3 degrees.

Total cream churned, 2671 pounds.

Average time of churning, 39.6 minutes.

Unworked butter secured, 729.25 pounds.

Amount of marketable butter secured, 692.25 pounds.

Amount of salt water worked out of butter, 78.50 pounds.

Per cent of unworked butter worked out as salt water, 10.7 pounds.

Number pounds of sweet cream necessary to make 1 pound of marketable butter, 3.85.

The butter for this month was worked very dry containing when delivered to the customers upon the average about 10 (9.71) per cent of moisture.

Observations upon Churning for May, 1890.

	1	2	3	6	7	8	9	9	10	12	13	14	15	16	17	19	20	21	22	23	24	26	27	28	29
Temperature of cream	40	35	48	60	52	62	62	46	...	...	...	...	62	60	60	57	58	62	62	62	64	60	60	57	60
	S†	S	S	S	S	S	S	S	...	...	...	...	A‡	A	A	A	A	A	A	A	A	A	A	A	A
Hours after separation	0	0	0	24	24	24	24	0	...	...	...	...	24	24	24	48	24	24	24	24	24	48	24	24	24
Pounds of cream churned	142	104	139½	264	200	203	189	76	...	...	...	...	210	202	232	218	366	281	274	278	248	264	278	253	252
Pounds of water added	37	25	20	15	20	0	50	10	...	...	...	...	20	10	12	10	13	2	6	13	7	20	20	20	0
Temperature of water	Ice	Ice	Ice	Ice	Ice	Ice	.....	Ice	...	...	...	...	......	Ice	Ice	Ice	Ice	Ice	Ice	Ice	Ice	Ice	Ice	Ice	Ice
Revolutions of churn per minute	40	40	40	40	40	40	40	40	...	...	...	...	40	40	40	40	40	40	40	40	40	40	40	40	40
Number drams of coloring	8	5	7½	14	10	10	8	3	...	...	...	...	10	12	20	10	16	12	12	12	12	12	12	11	10
Ounces of salt per pound of butter	1½	1½	1½	1½	1½	1½	1½	1½	...	...	...	...	1½	1½	1½	1½	1½	1½	1½	1½	1½	1½	1½	1½	1½
Minutes churning	39	60	31	25	30	13	10	16	...	...	...	...	8	12	22	19	20	22	15	20	13	15	15	20	16
Minutes draining buttermilk	20	20	20	20	20	20	20	20	...	...	...	...	20	20	20	20	20	20	20	20	20	20	20	20	20
Minutes draining wash water	20	20	20	20	20	20	20	20	...	...	...	...	20	20	20	20	20	20	20	20	20	20	20	20	20
Pounds of buttermilk	140	81	95½	87	150	149	150	62	...	...	...	...	150	155	180	140	270	207	202	230	190	187	170	135	180
Temperature of buttermilk at end of churning	52	48	58	62	54	63	63	53	...	...	...	...	64	62	62	59	60	64	64	65	65	62	63	60	62
Pounds of butter before working	38	28	39½	79	58	54	49	19	...	...	...	...	57	60	60	52	91½	66½	73	73	52	74	72	71	62
Pounds of butter after working	35¾	26	33	74	58½	53	63	......	...	...	...	...	52	59	60	52	91½	66½	73	73	52	74	72	71	62
Pounds of water worked out of butter	4	5½	3	10	3½	4½	5½	......	...	...	...	...	7	2½	3½	4	2½	3	3½	4	2½	2½	3	4	3¼

†Sweet. ‡Acid.

Summary of Observations upon Churning for Month of May, 1890.

Average temperature of sweet cream at beginning 50.6 degrees.

Average temperature of sweet cream at end of churning 56.6 degrees.

Increase of temperature by churning, 6 degrees.

Average time of churning 28 minutes.

Unworked sweet cream butter secured, 364.5 pounds.

Marketable sweet cream butter secured, 343.25 pounds.

Salt water worked out, 36 pounds.

Per cent. of unworked sweet cream butter worked off as salt water, 9.8.

Average temperature of acid cream at churning, 60.3 degrees.

Average temperature of acid cream at end of churning, 62.4 degrees.

Increase of temperatue by churning, 2.1 degrees.

Average time of churning acid cream, 16.6 minutes.

Unworked acid cream butter obtained, 8.64 pounds.

Marketable acid cream butter obtained, 858 pounds,

Pounds of salt water worked out, 48.25 pounds.

Per cent. of unworked butter worked out as salt water, 5.5.

It required 1317½ pounds of sweet cream to make 343¼ pounds of marketable butter, or 3.83 pounds of sweet cream produced 1 pound of marketable butter. It required 3356 pounds of acid cream to produce 858 pounds of marketable butter, or 3.91 pounds of cream to make I pound of marketable butter, supposing the cream to be uniform which it probably was. It required nearly 1-10 pounds more cream to produce 1 pound of acid cream butter, than to produce 1 pound of sweet cream butter.

Observations upon Churning for June, 1890.

	2	3	4	5	6	7	9	10	11	12
Temperature of cream	58	60	6	64	56	56	64	58	58	...
Hours after separation	48	24	24	24	24	24	48	24	24	...
Pounds of cream churned	28	292	236	240	197	70	163	267	100	...
Pounds of water added	20	20	28	24	30	10	15	20	12	...
Temperature of water	Ice	Ice	Ice	Ice	Ice	Ice	Ice	Ice	Ice	...
Revolutions of churn per minute	40	40	40	40	40	40	40	40	40	...
Number drams of coloring	10	10	10	10	8	4	8	12	5	...
Ounces of salt per one pound of butter	1½	1½	1½	1½	1½	1½	1½	1½	1½	...
Minutes churning	15	18	11	11	9	16	10	20	13	...
Minutes drawing butter-milk	20	20	20	20	20	20	20	20	20	...
Minutes drawing wash-water	20	20	20	20	20	20	20	20	20	...
Pounds of butter-milk	148	22	160	164	120	40	115	170	70	...
Temperture of butter-milk at end of churning	59	64	64	64	58	58	62	60	60	...
Pounds of butter before working	58	72½	68	64½	62	22	46	78	34	...
Pounds of butter after working	58	76	69	64	63	22	41½	72	33	...
Pounds of water worked out of butter	2½	2½	2	3	2½	1	7	8	2	...

	13	14	16	17	18	19	20	21	23	24	25	26	27	28	30
Temperature of cream	56	56	58	62	54	54	56	54	58	64	60	68	60	58	58
Hours after separation	24	24	48	24	24	24	24	24	48	24	24	24	24	24	48
Pounds of cream churned	....	184	167	218	163	167	200	204	207	238	173	301	225	232	267
Pounds of water added	16	20	8	20	20	20	20	20	20	20	20	30	21	23	30
Temperature of water	Ice	Ice	Ice	Ice	Ice	Ice	Ice	Ice	Ice	Ice	Ice	Ice	Ice	Ice	Ice
Revolutions of churn per minute	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40
Number drams of coloring	14	8	8	8	8	8	9	6	9	8	8	9	8	8	8
Ounces of salt per one pound of butter	1½	1½	1½	1	1	1	1	1	1	1	1	1	1	1	1
Minutes churning	30	25	13	10	13	15	12	9	12	10	9	15	13	15	16
Minutes drawing butter-milk	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
Minutes drawing wash-water	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
Pounds of butter-milk		142	115	140	125	120	150	135	115	170	160	210	176	173	200
Temperture of butter-milk at end of churning	....	.	....	64	56	58	56	56	60	66	62	66	62	60	60
Pounds of butter before working	113	67	62	78	52	56	71	68	61	66	58	55	55	60	55
Pounds of butter after working	113	67	64	68	50	58	76	70	68	58	60	86	57	60	57
Pounds of water worked out of butter	4	8	3	10	2	3	2	3	2½	2	2½	2	1	3	3½

Summary of Observations upon Churning Acid Cream, June, 1890.

Rejecting the days on which imperfect observations were made, we have the average temperature of cream at starting, 58.8 degrees.

Average temperature of cream at end of churning, 60.4 degrees.

Average rise temperature in churning acid cream, 1.6 degrees.

Total amount of acid cream churned, 4,729 pounds.

Average time of churning, 13 minutes.

Total amount of unworked butter obtained, 1,399 pounds.

Total amount of marketable butter obtained, 1,397½ pounds.

Total amount of salt water worked out, 78 pounds.

Per cent. of marketable butter worked off as salt water, 5.5.

Amount of acid cream necessary to produce 1 pound of marketable butter, 3.38 pounds.

The butter for this month was worked with a view of retaining within it as much moisture as possible. It appears to be the practice at some creameries to try to leave as large a quantity of water in the butter as possible, and this excess of water is sold as part of first-class creamery butter. It will be noticed that we have succeeded in this case, in producing marketable butter the weight of which was almost equal to the weight of the unworked butter. We do not believe that such a grade of butter as that manufactured during this month, ranging in all cases below 80 per cent. of butter fat, should be adopted as a fair, honest, butter. However, until a butter standard is established, we presume that dairy-men will continue to sell butter largely saturated with water. It is only a question of a little tact in the salting and working of butter to reduce the quantity of butter fat by the addition, or rather by the failure to work out the water, several per cent. It makes no difference whether the Creamery-man be working with acid or sweet cream butter, so far as the permitting of this adherent water to remain in the butter, is concerned.

The quality of the sweet cream butter is shown by the table of analyses following. The variation in the curd and salt contents is due to experimental work, and would not occur in ordinary dairy practice where a regular system is followed. It will be noticed that in all cases the standard of the butter was much above what is considered average quality of butter so far as fat content is concerned.

The averages of the churnings of acid cream and sweet cream for the period beginning November 1, 1889 and closing June 30, 1890, show that it required 3.95 pounds of acid cream to make 1 pound of butter and 3.74 pounds of sweet cream to make 1 pound of butter.

The observations for separating cream and for churning milk were taken by Mr. A. C. Magruder, the Creamery-man of the station; but the Director is responsible for the system of observations, the averages and conclusions.

Analyses of Sweet Cream Butter.

Kind.	Date.		Butter Fat.	Water.	Curd.	Ash.
Sweet	March	3	80.92 per cent	7.432 per cent	6.84 per cent	4.8 per cent
Sweet		15	79 984 per cent	9.94 per cent	5.752 per cent	4 424 per cent
Sweet		21	88.964 per cent	7.708 per cent	.616 per cent	.27 per cent
Sweet		22	80.108 per cent	12.82 per cent	.1412 per cent	5 66 per cent
Sweet		24	83.67 per cent	10 464 per cent	.76 per cent	5.1 per cent
Sweet		24	84.78 per cent	10.01 per cent	.1048 per cent	4 16 per cent
Sweet		27	87.496 per cent	11.08 per cent	.68 per cent	.74 per cent
Sweet		27	87 124 per cent	11.372 per cent	.624 per cent	88 per cent
Sweet		28	83.728 per cent	10.464 per cent	2.05 per cent	3 76 per cent
Sweet		28	83 22 per cent	10.46 per cent	1.7 per cent	4.62 per cent
Sweet	April	1	86 812 per cent	9. per cent	.568 per cent	3 62 per cent
Sweet		1	87.38 per cent	8.12 per cent	.88 per cent	3.62 per cent
Sweet		3	82.55 per cent	8 912 per cent	.88 per cent	2 64 per cent
Sweet		3	87 132 per cent	9.1 per cent	1 per cent	2.76 per cent
Sweet		5	85.396 per cent	9.052 per cent	1. per cent	4.37 per cent
Sweet		5	84.644 per cent	9.864 per cent	1.02 per cent	4.464 per cent
Sweet		7	82 22 per cent	9.636 per cent	1.15 per cent	6.99 per cent
Sweet		7	83.66 per cent	8.46 per cent	1.05 per cent	6.82 per cent
Sweet		8	81.888 per cent	10.328 per cent	.72 per cent	7.08 per cent
Sweet		8	82 064 per cent	11.78 per cent	95 per cent	5.2 per cent
Sweet		10	86.092 per cent	9.208 per cent	8.768 per cent	1.92 per cent
Sweet		10	87.28 per cent	8.352 per cent	.58 per cent	3.7 per cent
Sweet		12	85.62 per cent	8.256 per cent	5.412 per cent	.712 per cent
Sweet		15	88.04 per cent	9.288 per cent	1.56 per cent	1.104 per cent
Sweet		15	87.228 per cent	9.912 per cent	.696 per cen	2.1 per cent
Sweet		17	86.244 per cent	10.268 per cent	1.74 per cent	2.54 per cent
Sweet		17	85.8 per cent	10.02 per cent	....	....
Sweet		19	84.312 per cent	12.76 per cent	1.2 per cent	1.728 per cent
Sweet		19	84.656 per cent	12 18 per cent	.856 per cent	2.3 per cent

The Method of Analysis of Butter.

The method of analysis of butter adopted in making the following determinations was proposed by Dr- E. H. Jenkins of the Connecticut Experiment Station. The duplicate analyses show the difficulty in securing perfectly uniform samples of butter for analysis. In these analyses, the butter was not melted before weighing; the sample being drawn from the butter as finished ready for marketing.

Taking of Sample.

Take a piece of combustion tubing and force it into the butter at different points until a sufficient sample is obtained. This may be forced out of the tube by means of a close fitting cork pushed by a rod or stick.

For Moisture.

Weigh out accurately 2.5 grms. of the butter, and dry at temperature of boiling water until constant weight is secured. This is best done in a dish with a flat bottom of 3 or 4 square inches surface. It will generally be completed in from two to three hours, though heating for a longer time does not appear to change the weight either by loss or oxidation. Neither does heating it to 105 degrees C. appear to change the result.

Fat, Curd and Ash.

The dried butter from the water determination is treated in the dish with 76 degree benzine and stirred till the lumps disappear. It is then filtered on a weighed Gooch crucible. In order to secure complete extraction with a small quantity of benzine, after bringing on to the crucible, the latter is filled and allowed to empty without the use of suction until all fat is removed. Finally it is dried on the pump and then kept at 100 degrees C. for two hours and weighed. This weight less the weight of the crucible represents the curd and ash, and the difference between this and the dried butter represents the fat. The crucible is then heated below a red heat till its contents have burned white, and weighed again. The loss of weight is curd. The ash remains in the crucible. If dissolved, this may be removed by washing, and the salt determined by titration with Ag N O 3. The sample should be kept in a cool place.

Churn Test of Milk.

It has been claimed that the churn was the only test that could be relied upon in determining the value of milk, and in order to arrive at some idea of the reliability to be placed upon the churn test, he following churn tests were made under conditions as uniform as it is possible to make them :

Date 1889	Amount pounds.	Per cent. Fat.	Temp. Churned.	Condition.	Butter produced.	Butter produced per 100 lbs. milk.
Dec. 2	10	3.787	60 deg	Overchurned..........	6 oz	60 oz
" 2	10	3 787	60 "	Granules	5½ oz	55 oz
" 4	13	3.583	60 "	Overchurned..........	8 oz	61.5 oz
" 4	13	3.583	60 "	Granules	7¾ oz	59.6 oz
" 6	9	3 787	60 "	Overchurned..........	5½ oz	61.1 oz
" 6	9	3.787	60 "	Granules	5¾ oz	63.8 oz
" 9	19	4.093	60 "	Overchurned..........	14 oz	73.6 oz
" 9	19	4 093	60 "	Granules	13 oz	68.4 oz
" 11	14	3.787	60 "	Overchurned..........	8¾ oz	62.5 oz
" 11	14	3.787	60 "	Granules	9 oz	64.2 oz
" 13	13½	3 583	60 "	Overchurned..........	6 oz	44.4 oz
" 13	13½	3 583	60 "	Granules	6½ oz	48.1 oz
" 16	19½	3 583	60 "	Overchurned..........	14 oz	71.7 oz
" 16	19½	3.583	60 "	Grannles	15 oz	76.9 oz
" 20	14	3.379	60 "	Overchurned..........	8½ oz	60.7 oz
" 20	14	3.379	60 "	Granules	7 oz	5[illegible] oz
" 30	14	3 583	60 "	Overchurned..........	8¾ oz	62 5 oz
" 30	14	3 583	60 "	Granules	7½ oz	53.5 oz

In these tests in five cases out of nine, the overchurning of the cream gave an average of 6.36 ounces more of butter per hundred pounds of milk than did churning the cream to the granulated condition. Four cases out of nine tests, the overchurning of the cream gave an average excess of 3.32 ounces per hundred pounds of milk in favor of churning to the granulated condition. The butter made each day received the same amount of salt, and the result is given in good marketable butter; the weights being taken after the operation was completed.

Methods of Testing Milk.

The interest being developed in dairying has directed the attention of scientific investigators to some cheap and efficient means of quickly analyzing milk. A number of processes have recently been proposed, each having its defects, and each in its turn requiring the attention of the Chemist of the Station in testing its efficiency and detecting its weakness. All of the methods proposed contemplate the use of strong chemicals for setting free the butter fat in the milk and then measuring the quantity of fat or fatty acids liberated from the known quantity of milk, and calculating therefrom the per centage composition of the milk. Much time at the Station has been spent in endeavoring to arrive at the limits of error in each, and also in finding the defects or difficulties to be overcome. All of the methods proposed depend for their accuracy upon measuring the fat in an accurately graduated tube. Supposing the chemical work of the operation to be perfect, there will always be a liability o error in the irregular calibration and graduation of the tubes.

To the writer's mind, there appears to be no reason why such a process of milk analysis may not be made as reliable and accurate as an ordinary volumetric determination in chemical analysis. Until within comparatively recent years, the majority of chemists looked with a good deal of doubt upon results secured by volumetric processes: but the improvement in the manufacture of glass apparatus and in the methods of calibration and graduation, and the processes of analyses have so perfected the operations that for many kinds of analyses, the volumetric methods are accepted as being equally as reliable as gravimetric. The chemist in proposing to use any of these methods, must, of course, carefully test all of his apparatus before beginning operations in order to secure the utmost accuracy. The sources of error most frequently met with in our experience have been inaccuracy of gradution in the tubes for measuring the fat. The manufacturers did not appreciate the necessity of having the necks of the tubes of uniform bore, and this difficulty can only be overcome in the chemical laboratory by correcting all of the tubes for these errors, as is done in other careful work by volumetric methods.

Short's Method.

Short's method of analysis consists in digesting 20 c. c. of milk with hot alkali in a narrow necked flask prepared for the purpose until the caseine is decomposed and the butter fat converted into soap. The soap is then decomposed by hot acid, which further decomposes the caseine and liberates the fatty acids so that they may be collected and measured in the narrow tubular neck of the flask. The tubes in the latest form are graduated to give the per cent. of butter fat found in the volume of milk, and after the de composition is effected, nothing remains but to read off the percentage of fat in the butter.

The apparatus necessary for carrying on this operation consist of three pipettes, one holding 20 cubic centimeters for measuring the milk, and the other two each holding 10 c. c. for measuring the alkali and acids used. The scale, we think, should be engraved upon the tube; some manufacturers, however, furnish tubes that are not graduated, and with them, a millimeter scale for measuring the percentage of fat. It requires a water bath provided with the proper rack for holding the tubes while being heated and a wash bottle for holding hot water. The chemicals used are:

Solution No. 1 consisting of 8.75 ounces (250 grams) caustic soda, 10.7 ounces (300 grams) caustic potash, dissolved in 4 pounds (1809 grams) of water.

10 c. c. of this solution are added to the milk to convert the butter fat into soap, and to partially decompose the caseine.

After adding this solution to the milk, the tube is placed in the water bath and boiled continuously for about two hours until the whole mass assumes a dark brown color. During the process of boiling, the tubes should be shaken once or twice to be sure to have all parts of the milk perfectly acted upon.

Solution No. 2, consisting of equal parts of commercial sulphuric acid (oil of vitriol) and acetic acid. The acetic acid should have a specific gravity of 1.047.

After the milk and alkali have been boiled together for about two hours and the decomposition is quite complete, the tubes are removed from the water bath, cooled slightly and 10 c. c. of solution No. 2 added to each of them. The tubes are then returned to the water bath and boiled for an hour. They should be shaken two or three times during this digestion. Remove the tubes from the water bath and fill them up by means of the wash bottle with hot water to within an inch of the top, or if they are graduated tubes, so that all of the fat will stand within the graduated scale. The slight turbidity or coloration of the fat does not appreciably affect the accuracy of the result. These impurities may be very perfectly removed by allowing the fat in the tubes to crystalize and then remelting it. If lumps of caseine should rise with the fat, it indicates that the digestion has not been long enough, and care should be observed that these do not effect the reading of the result.

The same process may be used for the analysis of cream by mixing the cream thoroughly and withdrawing 20 c. c. of the well mixed cream, then by adding to this 60 c. c. of water and shaking vigorously until the cream is thoroughly mixed with the water. Take 20 c. c. of this mixture and introduce into the flask and proceed as if it were whole milk. The reading should be multiplied by four to find the correct per cent of fat in the cream. Our results in the analysis of cream by this method have not been so satisfactory as with whole milk.

The author of the process does not claim for it correct results for skim-milk containing less than one-half per cent of fat, as the relation to the composition of the skim-milk to the fat globules appears

to be changed in some way, so as to prevent the thorough separation of the butter fat.

The sources of error to be guarded against in this process are:

First. Unfair samples of milk.

Second. Inaccurate tubes, both for measuring milk and for measuring fat.

Third. Insufficient digestion with the alkali or acid.

Fourth. Inaccurate reading of the result.

The method, when properly handled, is believed to be sufficiently accurate for commercial purposes, and with proper experience may be relied upon as giving sufficiently accurate results for the determination of the quality of the milk received at the creamery. It is an important advance over the oil test so largely used in some parts of the country.

Patricks' Process, or the "Iowa Station's Milk Test."

The principle of Patricks' test, published in Bulletin No. 8 of the Iowa Station, February, 1890, is to dissolve the caseine and other ingredients of the milk by means of chemicals, and heat, and to allow the melted fat to rise and collect in a narrow tube, where its volume can be read with accuracy.

The complete apparatus consists of a sand bath or shallow pan holding sand provided with a rack which carries the tubes for heating, the tubes for containing the assay; an acid mixture; a pipette for measuring milk; a long stout pin for lowering the milk in the tube and a tube brush forcleaning the tubes. In place of a sand bath, he has recently proposed a brine bath containing a saturated solution of salt.

Patrick uses 10.4 c. c. of milk as the assay volume. He proposes three formulæ for the acid mixture:

Formula No. 1.

Pure acetic acid of 90 per cent. strength, 9 volumes.

Commercial oil of vitriol (sulphuric acid), sp. gr. 1.85, 5 volumes.

Mix, cool thoroughly, then add hydrochloric acid, sp. gr. 1.19, 1 volume.

Finally dissolve as much sulphate of soda (Glauber's salts) in the powdered form in this mixture as is possible by shaking or stirring, allowing a small excess of the crystals to settle to the bottom. Keep in a cool place in a glass stoppered bottle.

Formula No. 2.

Pure acetic acid, 90 per cent. strength, 9 volumes.

Commercial oil of vitriol sp. gr. 1.83, 5 volumes.

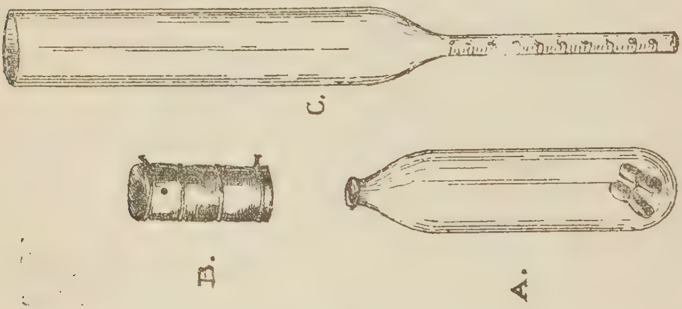
Mix, cool thoroughly, then add chemically pure hydrochloric acid, sp. gr. 1.19, 2 volumes.

Saturate with sulphate of soda (Glauber's salts), as in No. 1.

Bottle and preserve in the same way.

The most approved form of test tube devised by Patrick is shown in the accompanying cut, and has the advantage that the surface of the fat column can always be brought to the zero mark to facilitate the reading. It consists of two glass parts A. and C. and a thick rubber connecting tube B. The latter is wired firmly to A, but allows the grauduated neck C to be moved up and down inside of it with moderate friction. During the boilding, the neck is kept close down to A, but when the time for lowering the fat arrives, it is drawn up until its lower end is but a little below the small hole in the rubber B., and through this hole the liquid is easily withdrawn by the aid of a long, stout pin. Should the surface of the fat in lowering happen to be brought a little below the zero mark, or should it fall below by reduction of temperature, its position can at once be readjusted to that mark by pressing the neck a little lower into the rubber B. Some small pieces of pumice stone are placed in A. to prevent bumping during the digestion of the milk.

Fig. 4a.



Formula No. 3.

Acetic acid (pure) 90 per cent. strength, 9 volumes.

Sulphuric acid (oil of vitriol) spirit grains 1.83, 5 to 6 volumes.

Mix, allow to cool and add to the mixture about 2 per cent. by volume of rectified Methylic alcohol (wood spirit.)

From 13 to 15 c. c. of either of these solutions is added to each assay.

Method of Procedure.

Measure the assay volume 10.4 c. c. of milk into a tube by means of the pipette. Now pour in acid mixture in a small stream in the small test bottle to within an inch or less of the neck, leaving room for mixing the contents. Shake vigorously to thoroughly mix the acid and the milk, add acid mixture again up to three-forths of an inch above the top of the neck. Wipe the outside of the tube dry

and place it in the rack on the sand bath, or in the brine bath. The sand bath should contain sand free from gravel to the depth of about half an inch, a little more if a very hot fire is to be used. When all the samples of milk are prepared in this way and placed upon the sand bath, heat over a brisk fire (an ordinary kitchen stove, oil or gasoline stove may be used) bringing the contents of the tubes to a boil, and boil briskly but not violently for 4 to 6 minutes; by this time, the froth which at first forms will have dissappeared and the curd of the milk will be dissolved.

Acid mixture No. 1, does not develop any turbidity, but requires a little longer boiling than it does with No. 2, which will develop turbidity if the boiling continues too long.

No. 3 is used upon composite samples or preserved milk. In using this solution, throw into the tube on top of charge about a thimble full of anhydrous sylphate of soda.

The tubes may be made to boil regularly by raising or lowering ing them in sand; the ones boiling too rapidly being drawn out, and the ones not boiling with sufficient rapidity being pushed farther into the sand. After boiling a sufficient length of time, the sand bath may be removed from the stove to check the boiling, or it may be done by lifting the tubes for a moment from the sand; this will allow the fat to rise to the surface. As soon as the fat has risen, set the sand bath again over a heat sufficient to boil the contents of the tubes gently so as to move the fat layer up and down to mix it slightly with the surface portion of the acid liquid. This operation clarifiies the fat and relieves it from any inclosed impurities. If the fat is not clear after five minutes of this treatment, sprinkle upon the fat layer while it is being gently agitated as described, a little "efflorsced" sulphate of soda. If perfect clarification does not ensue almost immediately repeat the dose under the same conditions. Under this treatment, the time required for complete clarification with a fresh milk rarely exceeds eight minutes, and usually five suffice. Now remove the entire apparatus from the stove.

Effloresced sulphate of soda may be secured by pulverizing common Glauber's salts and exposing a thin layer of the powder to the air for a few days until the water of crystalization passes off, when it will be a fine, white powder. The finer and dryer it is, the better. It is used for clarifying the fat in the tube and in the preparation of the solutions.

For any purposes, where moderate accuracy is demanded, it suffices to at once lower the fat into the neck of the tubes and measure; but where greater accuracy is desired, after slight cooling, they should be set all at once by the movable rack into a pail of water kept at about 140 degrees F., and left there for 7 to 8 minutes before lowering. This brings the fat to the correct temperature, also makes it still clearer and renders exact measurement easier. After lowering the fat, the tubes should be replaced in the water for a few minutes to allow the fat to drain down completely before

reading; the readings may then be taken after an immersion of 10 to 15 minutes all told.

Lower the fat into the neck of the tube through the hole in the rubber band by using a stout pin which accompanies the tubes, as a lever to raise the rubber from the orifice in the tube lying just under the circular hole in the copper ring and allow the acid liquid to escape.

Both the upper and lower surfaces of the fat should be perfectly clean and distinct when the measuring is done. Should either be obscured by small bubbles and adhering brown liquid, these can be readily removed by inserting in their midst a slender splint of broom corn, twirling it rapidly between thumb and finger, and then returning the tube to the warm water to settle for a few minutes. As the broom splint is withdrawn, allow the adhering trace of fat to drain off upon the glass just above the column of fat.

Measure the fat from the extreme upper to its extreme lower surface; pay no attention to the meniscus—the dark crescent shaped appearance just below the upper surface.

The numbers on the graduations indicate percentages of butter fat, by weight—that is, pounds of butter fat per 100 pounds of milk. Each small division means .2 of one per cent., that is one-fifth of a pound per 100 pounds of milk), and it is easy to read to one-half, and with practice even to one-fourth of a division.

In ungraduated tubes, the fat is measured with a small millimeter scale, in which case, special directions accompany each set of tubes.

Special Precautions.

1. In charging the tubes, empty the pipette completely of milk, draining for a few seconds and blowing through it.

2. Bring the contents of the tubes to a boil as quickly as possible. If acid mixture No. 2. is used, boil briskly only four minutes; much longer boiling is liable to make clarification more difficult.

3. After the first boiling is over and all boiling has ceased, allow sufficient time (two or three minutes usually) for all the fat to rise to surface before commencing clarification. Observation through the neck of the tube toward the light of a window will tell when all has arisen.

4. In clarifying, boil only briskly enough to agitate the fat and mix it with the surface portion of the acid liquid, but not briskly enough to carry any fat down again into lower part of the tube.

5. In lowering the fat, rest the tube on some support; do not try to hold it in mid-air.

6. If the plan of hot reading be adopted, *i. e.* reading as soon as clarification is done, without setting into water—make sure before reading that all the fat has risen to the surface.

7. Where only comparative analyses are being made, the standing of tubes in water at 140 degrees F. can be omitted; but it gives results in this ease from .15 to .25 per cent. higher than where an immersion of half an hour has been followed. It seems to be necessary to allow the fat to stand at about 140 degrees for twenty or

thirty minutes in order that it may assume a fixed volume. Where a number of tests are made at the same time, an extra rack is provided for them, so that they may be immersed in hot water as they are completed by the sand digestion.

Where only comparative analyses are made, and the short cut plan of reading the fat hot is taken, about one-half dozen tests may be made in half an hour.

Sources of Error.

The only danger of error from a chemical source appears to be the failure to completely dissolve the non-fatty parts of the milk. The operator, however, can always tell whether the method is working satisfactorily or not, as a clear, nearly or quitet transparent solution of the milk with a clear fat layer free from curd or scum is a sure proof of the successful working of the test.

The digesiton by Patrick's method is more satisfactory than by Short's method, and less liable to have errors arise from imperfect digestion. It also has the advantage of requiring less time and of having the whole process performed by one operation. The lowering of the liquid, however, is inconvenient, and trouble with the rubber tubes is liable to arise. It is, however, a valuable addition to our methods of milk analysis.

As in Short's method, the graduation of the tubes is the chief source of error to which the method is liable, and the only protection that the chemist has from error arising in this manner is to carefully test all the tubes used by him. The manufacturers of these various tubes are liable to be careless, and unless it is understood that inaccurate tubes are to be returned to them at their expense, one is apt to secure a large proportion of inaccurately graduated tubes. The Iowa Station agrees to test, free of charge, the tubes that are sold by J. F. McLain, of Ames, Iowa.

Cream by this method is tested by diluting with two or three volumes of water, multiplying the result by three or four according to the dilution. The results by this process appear to be a fraction higher than those secured by the gravimetric method for whole milk and skim milk and a fraction lower for cream.

Some results by Shorts' and Patricks' methods as they appear in the ordinary work of the creamery is shown by the following:

I		II	
SHORTS'.	PATRICKS'.	SHORTS'.	PATRICKS
A. 4.75	4.50	A. 3.50	3.50
B. 4.50	4.44	B. 4.65	4.78
C. 3.40	3.67	C. 4.40	4.44
D. 4.30	4.38	D. 4.40	4.44
E. 5.90	5.07	E. 4.25	4.11
F. 4.25	4.23	F. 4 70	4.49
G. 3.90	3.88	G. 4.35	4.38
H. 4.25	4.22	H. 4.35	4.38
I. 4.50	4.56	I. 3.25	3.11
		J. 4.20	4.22

Cochran's Method.

The other process depending upon the action of chemicals and somewhat similar in principle to that of Patricks', is the Cochran method. He claims to hold a patent upon it. The particular form of apparatus no doubt is patentable; but it would be as reasonable to patent electi city as a chemical reaction. The apparatus essential to conducting this process is a steam boiler with a wire rack in it for holding the tubes while being heated; a pipette for measuring the milk, one for measuring ether, one for measuring acid, and a digesting flask having two narrow necks, the flask holding about 100 cubic centimeters. The larger neck enters the flask about half way up, and the narrow neck, carrying upon it a scale, enters it at the top.

The chemicals used are:

Good commercial sulphuric acid specific gravity 1.82.

Acetic acid, sp. gr. 1.073.

These may be mixed, but if so, care must be taken to keep the bottle closely stoppered to prevent the escape of the volatile acid. Ordinary, ether, which should be kept in a cool place well stoppered, and never poured out when near a naked flame.

A pound of each of these reagents will suffice for about 200 analyses.

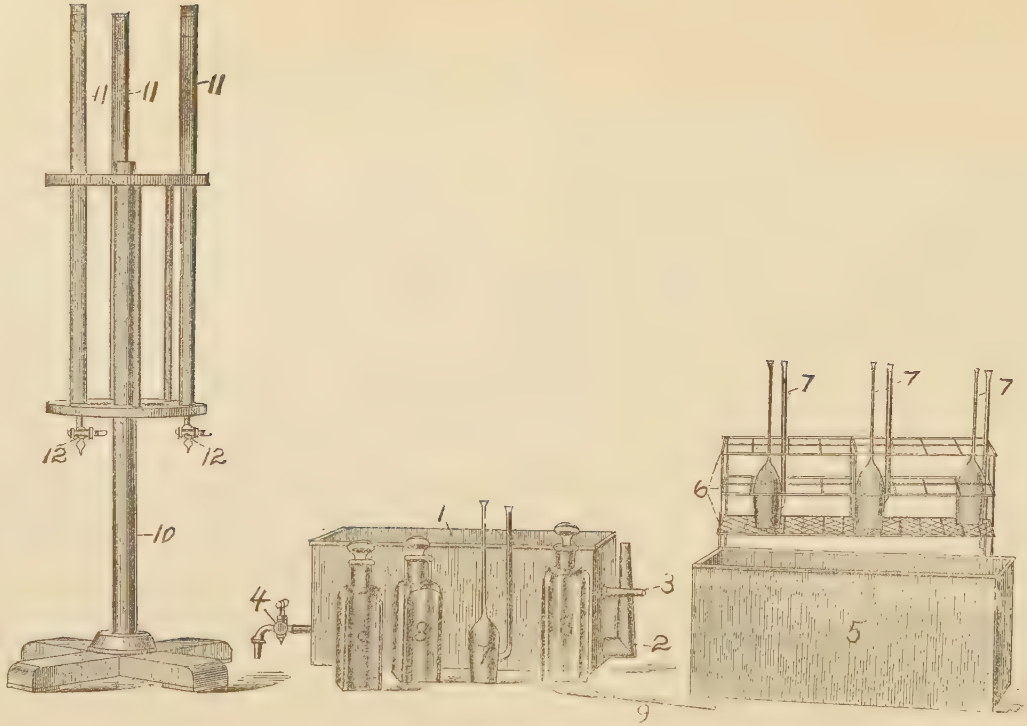
The process of analysis is as follows:

5 cubic centimeters of thoroughly mixed milk, or cream diluted as in Short's method, is measured into the wide mouth of the flask.

5 cubic centimeters of the acid mixture or 2 and ½ c. c. of each, if kept separately, are added to the milk, and the sample thoroughly shaken. In the meantime, the water in the water bath is heated to boiling, and the wire rack so placed that the flasks will be immersed about one-half inch in the boiling water. The flasks containing the milk and acids are heated for five or six minutes, shaking thoroughly once or twice to keep the contents well mixed. Then place the flask in cold water. When the flask is cooled, measure out 4 c. c. of ether. Mix thoroughly with the contents of the flask by shaking, and set in the boiling water again until no smell of ether can be perceived at the mouth of the flasks; this usually takes ten to fifteen minutes. The fat is thus brought to the surface in a clear layer. The flask may then be filled up with hot water above the mouth of the side tube, care being taken that no fat enters it. Should any enter, it may be drawn back into the flask by blowing upon it. Some care will be required to see that none of the butter fat clings to the side of the flask. It should all be carefully worked to the surface by shaking or jarring the flask before filling with hot water to the narrow neck. Hot water is then carefully run into the side tube, causing the fat to rise in the graduated tube.

If the column of fat in the tube be broken by bubbles of water or air, continuity can be restored by running a small broom splint

COCHRAN'S MILK TESTING APPARATUS.



1. Boiler.
2. Pipe to convey steam to boiler.
3. Overflow pipe.
4. Spigot.
5. Cooling pan.
6. Rack to hold fat indicators (testing flasks.)
7. Patented fat indicators (testing flasks.)
8. Bottles holding acids and ether.
9. Pipette.
10. Burette stand.
11. Burettes.
12. Stopcocks on burettes.

or polished wire down through it and twirling it. Allow any adherent fat to drain off be'ore removing it.

The division upon the scale reads per cents to one-tenth of one per cent. The reading should be done while the column is hot, and should extend from the upper surface of the top bottom of the fat column. The difference in reading will give the per cent.

The table supplied with the instruments gives the per cent. of fat per hundred pounds of milk :

Percentage of Fat Corresponding to Cochran's Measures.

Measure of fat.	Per cent. in milk.	Measure of fat.	Per cent. in milk.	Per cent. in cream.	Measure of fat.	Per cent. in milk.	Per cent. in cream.	Measure of fat.	Per cent. in cream.
0.5	.173	10.0	3.46	7.03	20.0	6.92	14.06	30.0	21.09
1.0	.346	10.5	3.63	7.38	20.5	7.09	14.41	30.5	21.44
1.5	.519	11.0	3.80	7.73	21.0	7.26	14.76	31.0	21.79
2.0	.692	11.5	3.97	8.08	21.5	7.43	15.11	31.5	22.14
2.5	.765	12.0	4.15	8.44	22.0	7.61	15.47	32.0	22.50
3.0	1.038	12.5	4.32	8.79	22.5	7.78	15.82	32.5	22.85
3.5	1.211	13.0	4.50	9.14	23.0	7.95	16.17	33.0	22.20
4.0	1.384	13.5	4.67	9.49	23.5	8.13	16.52	33.5	23.55
4.5	1.557	14.0	4.84	9.84	24.0	8.30	16.87	34.0	23.90
5.0	1.730	14.5	5.01	10.19	24.5	8.47	17.22	34.5	24.25
5.5	1.903	15.0	5.19	10.54	25.0	8.65	17.57	35.0	24.60
6.0	2.076	15.5	5.35	10.89	25.5	8.83	17.92	35.5	24.95
6.5	2.249	16.0	5.53	11.25	26.0	9.00	18.28	36.0	25.31
7.0	2.422	16.5	5.70	11.60	26.5	9.17	18.63	36.5	25.66
7.5	2.595	17.0	5.88	11.95	27.0	9.34	18.98	37.0	26.01
8.0	2.768	17.5	6.05	12.30	27.5	9 51	19.33	37.5	26.36
8.5	2.931	18.0	6.23	12.65	28.0	9.69	19.68	38.0	26.71
9.0	3.114	18.5	6.40	13.00	28.5	9.86	20.05	38.5	27.06
9.5	3.287	19.0	6.57	13.36	29.0	10.03	20.39	39 0	27.42
		19.5	6.74	13.71	29.5	10.20	20.74	39.5	27.77
					30.0	10.38	....	40.0	23.12

As used at present, it is intended only for commercial analyses; but by making finer divisions upon the scale, it can be made use of for closer determinations, if handled with proper care. The apparatus is sold by Marshall & Cochran, 215 North Fifth street, Philadelphia, Pa.

All the methods described depend entirely upon chemicals for effecting the separation of the fat from the milk. Each of the methods can be relied upon for commercial analyses, and really mark a great advance in the process of analysis of milk. By the careful and proper graduation of the tubes; it is indeed entirely within the range of possibilities that by them analyses of milk may be quickly made, giving results comparable with the gravimetric method.

None of them, however, are quick enough to fully answer the purpose of testing milk for creameries, and during the year, two more advances in the process of milk analysis have been made. One by Dr. Babcock, of the Wisconsin Station; another by the Vermont Station, which has been tested, or at least the chemical investigations have been carried on under the direction of Dr. Cook of that Station. The machine is called Beimling's apparatus, the machine itself being patented by him. The Babcock apparatus is not patented by him, but forms of apparatus for carrying out his process have been patented.

Any method to be satisfactory should possess the following qualities, *i. e.:* 1st. It should be simple, requiring no knowledge of chemistry and little skill in handling apparatus. 2nd. It should be cheap both as to apparatus and chemicals used. 3rd. It should be accurate, and the more accurate it is, the better. The analyses for commercial purposes should be reliably made to about .1 of 1 per cent. 4th. The method should be rapid, so that a large num per of analyses may be made in a short time. While the three methods already discussed require from one to three hours to complete a series of twenty samples, with the apparatus of Beimling or Babcock, the work may be more perfectly done in an half hour or less.

The apparatus which I shall next describe is Babcock's Apparatus, a cut of which is herewith represented.

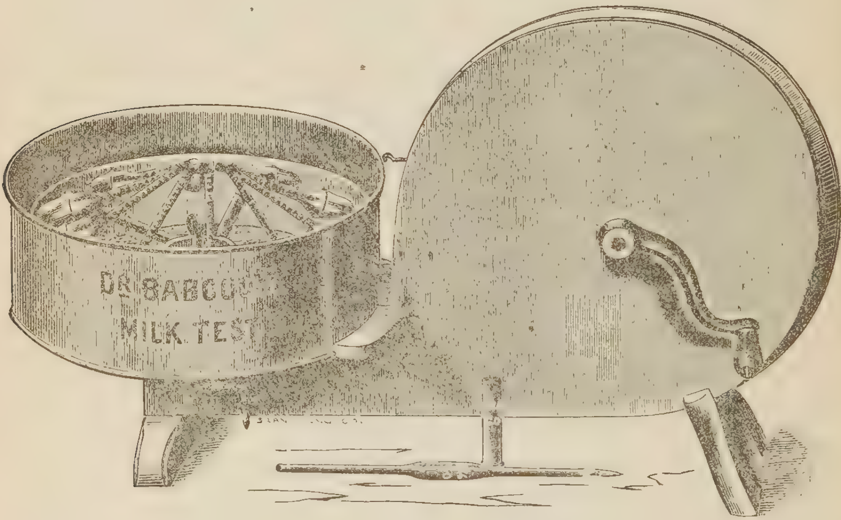


Figure 5.

"1. Test Bottles. These are of the same form as the bottles used in Short's test, but are made a little smaller and of heavier glass. They should contain up to the neck not less than 40 c. c. and not more than 45 c. c. Each division of the graduated scale upon the neck represents .04 c. c., and in order to facilitate the reading, the neck is made of such a diameter that the marks of the scale are about 1½ millimeters apart. Five of these divisions are equivalent to one per cent. of fat when 18 grams of milk are used in the test, it being assumed that the specific gravity of the butter fat, at the temperature at which the reading is made (about 120 degrees Fahr.) is 0.9." Each division, therefore, on the scale corresponds to one-fith of one per cent.

2. Pipette for measuring milk. This may be of any form, but one with a rather wide opening at the lower end, to allow the milk to run out rapidly is to be preferred. It should contain when filled to the mark, 17.6 c. c. A pipette of this size will deliver a little less than 17.5 c. c. of milk. The quantity of the milk required for the test sample of 18 grams is 17.44 c. c., if the milk has the average specific gravity of 1.032.

3. A measure for the acid. A graduate or cylinder of glass with a lip to pour from and a single mark at 17.5 c. c. is the best for general use. In laboratories, a large burette holding 100 c. c. or 200 c. c. with marks at each 17.5 c. c. and having a glass stop cock, may be used to advantage, but on account of the liability to breakage is not be recommended in factories or private dairies.

4. Centrifugal machine. Any kind of centrifuge may be used that will give a speed of from 700 to 800 revolutions per minute. The cut, furnished by Cornish, Curtis & Greene, of Fort Atkinson, Wisconsin, represents the particular form of machine supplied by them.

The form devised by Dr. Babcock is mounted on a stand not dissimilar to the stand of a separator. The tubes containing the acid are shown in place in the cut. The cylinder is made to revolve by means of a crank with a band running on large and small pulleys, giving a horizontal motion to the tin cylinder carrying the test bottles. This is provided with a cap and with provisions for supplying it with hot water or steam. For this purpsse, a kerosene lamp or Bunsen burner may be used, or connections may be made with the boiler so as to keep a constant supply of steam in the jacket.

The chemical used is commercial sulphuric acid, having a specific gravity of 1.82. Stronger acid should not be used, as it chars the fat.

The pipette for measuring milk and the measuring flask for the acid are shown in the cut.

Making the Test.

Sampling the milk. Every precaution should be taken to have sample represent as nearly as possible the whole lot of milk from which it is taken. The milk should be poured several times from one vessel to another, or agitated in such a way that the sample may be thoroughly mixed. No clots of cream should appear on the surface or small granules of butter. Sour milk is very difficult to sample, and where it is necessary to analyse it, a pint of the well stirred milk should have the curd disolved by mixing with it 5 per cent. of strong ammonia water. When this is done, 5 per cent. must be added to the result obtained in order to get the correct percentage.

The milk is measured into the tubes by means of a pipette furnished with the apparatus for that purpose. The tubes may all be numbered, and all receive the samples of milk one after another, by rinsing the pipette with the milk before drawing it full of the sample to be used. The sample should always be drawn immediately after

thorough shaking so that the milk measured off will fairly represent the whole milk. The acid is then measured into the test bottle, which may stand a day or two, if necessary, without changing the results.

If curd is formed in the tube, it should be broken up by thoroughly skaking it.

The amount of commercial sulphuric acid required is approximately 17.5 c. c. If less is used, the caseine is liable to be imperfectly dissolved and rise in the column of fat. If more than 17.5 acid is used, the fat is liable to be attacked by it. The acid and milk should be thoroughly mixed by shaking. At first a precipitate of curd from the milk appears, which rapidly dissolves. A large amount of heat is formed by the chemical action of the acid upon the milk, and the solution soon becomes a dark brown. After standing a short time, the fat begins to accumulate on the surface having the appe rance of dirty cream.

Dr. Babcock ives the following description of making the test:

Whirling th ottles. The test bottles containing the mixtnre of milk and acid may be placed in the machine directly after the acid is added, or they may stand several hours without harm. An even number of bottles should be whirled at the same time, and they should be placed in the wheel in pairs opposite to each other, so that the equilibrium of the apparatus will not be disturbed. When all of the test bottles are placed in the apparatus, the cover is placed upon the copper jacket, and the machine is turned either by hand or by power at such a rate that the wheel carrying the bottles will make from 600 to 800 revolutions per minute, and this motion must be kept up for six or seven minutes. If this wheel is less than about 20 inches in diameter the speed should be greater, or else the whirling should be continued for a longer time.

When the bottles are placed in the machine directly after the acid is added, the separation may be affected without any extra heat, as that caused by the chemical action is sufficient to keep the fat liquid. If the bottles have stood after the acid is added until the contents are cooled below 100 degrees F., the water in the tank should be warmed to about 200 degrees F. before putting the bottles in the machine. The bottles should be kept heated in the machine as high as the boiling point of water while the separation is being effected. The proper degree of heat may be obtained by lighting the burner or kerosene stove under the jacket when the machine is started; so much water having been poured into the jacket as will be just heated to boiling when the whirling is finished. In this way, hot water is always available for filling the tubes at the proper time. In creameries, heat can be most easily supplied by steam connection with the boiler. If the machine is stopped for about six minutes, a layer of fat will be found upon the upper surface of the liquid in the tubes. This fat will not usually be clear; this, however, will make no difference in the result, as the subsequent treatment will clarify it.

As soon as the bottles have been sufficiently whirled, they should

be filled to the neck with hot water. This is most conveniently done by placing a vessel containing boiling water above the machine, and by means of a syphon, made from a small rubber tube with a glass tip, run the water directjy into the bottles without removing them from the wheel. The flow of water can be perfectly controlled by a pinch-cock upon the rubber tube If only a few tests are to be made, the bottles may be easily filled with a pipette, or by pouring from a graduate. The cover should then be replaced and the machine turned for one or two minutes, after which more hot water is added, filling the tube to about the seven per cent. mark. The fat will slowly rise into the graduated tube losing its cloudy appearance as it passes through the hot water. When all the bottles are filled, the cover is put upon the tank and the machine again turned for a short time. During this time, the water in the tank should be kept hot either by placing a lamp or kerosene stove beneath it, or by pouring in a quantity of boiling hot water before starting the machine. If the fat in some of the tubes still has a cloudy appearance, the cover should be placed upon the tank and heat applied for a few minutes, when the fat should become clear and in condition to be measured. The clearing may be hastened by whirling the tubes while hot. When the bottles are allowed to cool off to a point where the fat will crystallize and then warmed again, the fat will usually be much clearer than before, but as this does not materially change the volume of fat, it is considered unnecessary. Even a slight cloudy appearance does not harm. Measuring the fat: The fat when measured should be warm enough to flow readily, so that the line between the acid liquid and the column of fat will quickly assume a horizontal position when the bottle is removed from the machine. Any temperature between 110 degrees F. and 150 degrees F., will answer, but the higher temperature is to be preferred. The slight difference in the volume of fat due to this difference in temperature is not sufficient to materially affect results. A difference in temperature of 40 degrees F., will make less than one-tenth per cent. difference in milk containing five per cent. of fat. To measure the fat, take a bottle from its socket, and holding it in a perpendicular position with the scale on a level with the eye, observe the divisions which mark the highest and lowest limits of the fat. The difference between these gives the per cent. of fat directly. The reading can easily be taken to half divisions or to one-tenth per cent.

If the column of fat is less than about one division, as will sometimes happen with skim-milk, butter-milk, or when it may assume a globuler form instead of a uniform layer across the tube; when this occurs, the fat can usually be estimated with sufficient accuracy by simple inspection, but if an accurate reading is desired, it may be obtained by taking four samples of the milk in four test bottles, and after treating them in the usual way, until the bottles are ready to be filled with water, adding water to three of them only, filling them as full as possible without running them over. After whirling them for a minute to bring the fat all into the neck, the fat may be

poured off from these three tubes into the fourth. If any fat remains adhering to the sides of these tubes, they should be filled a second time with water and the remaining fat poured into the fourth bottle, which is then filled with water, whirled, and the reading taken; this divided by four will give the per cent. of fat. A better way would undoubtedly be to have a special test bottle, holding three or four times as much as the ordinary bottle, that could be used for skim-milk, butter-milk and whey. Three or four times the usual test sample could then be taken, and by adding the proper quantity of acid, the test could be made without transferring the fat.

Cream. The chief difficulty in testing cream lies in the sampling. Cream that is sour, or that has been exposed to the air until the urface has dried, can not be accurately sampled. The same is true of centrifugal cream that is badly frothed. Sweet cream from Cooley cans, that is not too thick to flow readily from the pipette, may be tested with satisfactory results. The process, however, must be modified slightly from that used with milk, as the amount of fat in cream is so large that it can not be measured in the ordinary test bottle, if the usual quantity is taken for the test, besides a much greater error results from the cream which adheres to the pipette than with milk. Both these difficulties may be overcome, by taking two or three test bottles and dividing the test sample into as nearly equal portions as can be judged by the eye. The pipette is then filled with water, and this is run into the tubes in the same way as the cream. If three bottles are taken the pipette is filed with water a second time and emptied into the bottles as before. This serves to rinse the cream from the pipette, and at the same time to dilute it to a point where it can be tested in the same way as milk. The bottles are then treated in the usual manner, and the reading of the of the tubes added together for the per cent. in the cream.

Owing to the low specific gravity of cream, the test sample, if the same volume, will weigh less than that of milk, and consequently the per cent of fat as shown by the scale will be less than is found by the gravemetric analysis, in proportion as the weight is less than 18 grams. Where a delicate balance is available, this error may be entirely avoided by weighing the cream used in the test, and calculating the per cent. of fat by multiplying the scale reading by $\frac{18}{a}$, *a* being the weight of the cream.

If 17.6 c. c. of cream is taken, and the portion adhering to the pipette is rinsed into the test bottle, a close approximation of the true result may be obtained without weighing, by correcting the scale reading as follows: For a scale reading of 20 per cent., add .25 per cent.; for a scale reading of .15 per cent., add 0.1 per cent. Readings between these may be corrected in proportion. Below 10 per cent. no correction is necessary.

In Dr. Babcock's hands, (as published in the Seventh Annual Report of the Agricultural Experiment Station of the University of

Wisconsin) the analyses by this method compare very satisfactorily with those by gravimetric analyses; being approximately .1 lower. In our hands, while the analyses are very uniform among themselves, they run appreciably lower than analyses made by the Adams' method. By using a proper co-efficient of correction, it would be possible, however, to make the results correspond very closely with those secured by the Adams' method.

The expense of the analyses is insignificant, being less than a half cent a test, and by proper care in handling the bottles, very little breakage need occur. The holders for the bottles in revolving cylinders should be packed with cork, rubber or some other material to prevent the glass from coming in contact with the metal, which will have a tendency to crack the bottles under the severe pressure of the centrifugal force.

Some difficulty may be experienced until the operator becomes acquainted with the use of the chemicals; time of digestion, etc. in order to get the fat in the neck of the tube free from caseine. We have encountered this difficulty in endeavoring to carry out the instructions given by Dr. Babcock; but have generally succeeded in getting the caseine fully dissolved by allowing the milk and acid to stand together for some time before putting it into the centrifuge. No doubt improvements will be made upon the machine in this particular but with some experience, as it is, little difficulty will be found in arriving at results sufficiently accurate for all commercial purposes. See comparative analyses.

Beimling's Method.

The Beimling apparatus, a cut of which is here presented, manufactured by H. F. Beimling, 214 Pembrok Place, Philadelphia, Pa. The apparatus consists essentially of a centrifugal machine, which is patented and so arranged that during revolution, the tubes will stand out in a horizontal position, giving the full effect of the the centrifugal force upon the milk. The machine for making six tests at a time could be carried in a good sized valise, and fastened to a table or window-sill without inconvenience.

The cut shows the form of test bottle, which is not unlike the bottle used in Short's method. It also shows the two pipettes; the larger one holding 15 c. c., and the smaller one holding 3 c. c., used for measuring acid. The chemicals used consists of two liquids made by mixing equal parts of rectified amyl alcohol (fusel oil), and concentrated hydrochloric acid, specific gravity 1.16. The second is ordinary commercial oil of vitriol, sp. gr. 1.83. The sample of milk is introduced into the bottle by means of a pipette. Use care to secure the last drop of milk. Then a 3 c. c. pipette is filled with the amyl alcohol and hydrochloric mixture which is added to the milk in the bottle and thoroughly mixed with it by shaking vigorously. The test bottle is then filled nearly to the neck with the oil of vitriol and vigorously shaken until the acid is well mixed with the milk and the curd almost if not entirely dissolved. Care

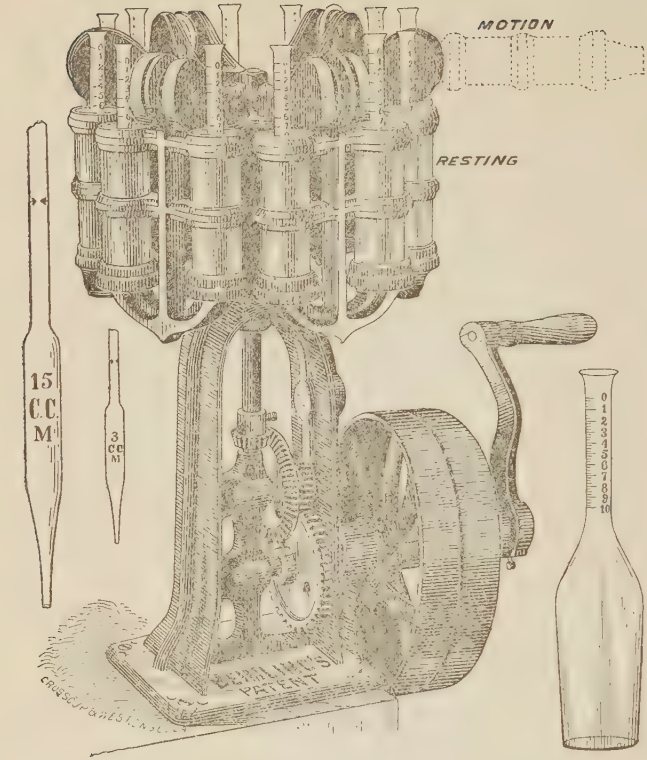


Figure 6.

will have to be observed in this part of the operation, and it will be found convenient to have a small cork for the test bottle to be used while shaking, and withdrawn several times during the operation to allow the air and gas to escape. Considerable heat will be developed by this operation, and it is well to have the bottle wrapped in a towel, or or some other convenient article, to keep it from burning the hands during the shaking: Instead of a cork, an ordinary rubber cap for the finger, such as is on sale at most drug stores may be used. After this has been thoroughly mixed, the bottle is immediately filled to tne zero point with the oil of vitriol, which is mixed with the rest by tipping the bottle upside down a couple of times, and is then placed in the centrifugal machine. A half dozen tubes may be filled in this manner, set in the centrifugal machine and whirled vigorously for half a minute to a minute. On stopping the machine, the clear butter fat will be found in the neck of the bottle, the column of which represents the per cent. of butter fat in the milk.

The danger of cracking the bottles may be largely avoided by placing a disk of cork in the bottom of the metal tube intended to hold the test bottles. This prevents them from coming in contact with the uneven bottom during whirling and will reduce breakage. (Suggested by Dr. Millspaugh after our assistant had broken several bottles. No breakage has occurred since its adoption).

The fat comes up clearly and sharply, and the divisions of the column upon the scale should be read from the extreme limits of the fat column.

The tubes should be kept warm enough to keep the fat column melted, as slight depression of the column gives incorrect results.

In using Hite's table for rapid calculations of the fat content of milk, it must be remembrred that the regular tubes furnished with the Beimling machine are graduated to degrees and tenths of degrees. One degree represents 0.87 per cent of the butter fat. One-tenth degree, therefore, represents .087 per cent.

By using a magnifying glass in extending the scale as practiced at this Station, the table gives the reading for the scale to one-fourth of a tenth of a degree. Thus, for one degree and a little excess, by the magnifying glass estimate what part of the space between one degree and one-tenth degree is the correct reading. If we find it to be 1.025, the per cent of fat is 0.892 per cent. If the correct reading be 1.050, the correct per cent of fat is 0.913 per cent. If the correct reading be 1.075, the per cent of fat is 0.935. If the correct reading be 1.1, the per cent of fat is 0.957.

In using the table, a little time will be necessary to acquire skill to read quickly and accurately with a magnifying glass; but we have been able to accomplish it by a little practice, and after having assured ourselves of the accuracy of the tubes, find it an extremely convenient and quick method of determining the fat in milk.

HITE'S TABLE.

HITE'S EXTENDED TABLE FOR THE RAPID ESTIMATION OF BUTTER FAT BY BEIMLING'S METHOD. THE TUBES GRADUATED TO DEGREES AND TENTHS OF DEGREES. ONE DEGREE REPRESENTS 0.87 PER CENT. OF BUTTER FAT.

Degrees and tenths of degrees, as engraved upon the tube.	Percentage of butter fat for degrees and tenths of degrees, as shown by the divisions of the scale on the tubes.	Percentage of Butter fat for ¼ of the smallest division, or 0.025 added to the percentage for degrees and tenths	Percentage of butter fat for ½ of the smallest division, or 0.050 added to the percentage for degrees and tenths.	Percentage of butter fat for ¾ of the smallest division, or 0.075 added to the percentage for degrees and tenths.	Degrees and tenths of degrees, as engraved upon the tubes.	Percentage of butter fat for degrees and tenths of degrees, as shown by the divisions of the scale on the tubes.	Percentage of butter fat for ¼ of the smallest division, or 0.025 added to the percentage for degrees and tenths.	Percentage of Butter fat for ½ of the smallest division, or 0.050 added to the percentage for degrees and tenths.	Percentage of butter fat for ¾ of the smallest division, or 0.075 added to the percentage for degrees and tenths.
Scale	0.000	0.025	0.050	0.075	Scale	0.000	0.025	0.050	0.075
0.0	0.000	0.022	0.043	0.065	5.1	4.437	4.459	4.480	4.502
0.1	0.087	0.109	0.130	0.152	5.2	4.524	4.546	4.567	4.589
0.2	0.174	0.196	0.217	0.239	5.3	4.611	4.633	4.654	4.676
0.3	0.261	0.283	0.304	0.326	5.4	4.698	4.720	4.741	4.763
0.4	0.348	0.370	0.391	0.413	5.5	4.785	4.807	4.828	4.850
0.5	0.435	0.457	0.478	0.500	5.6	4.872	4.894	4.915	4.937
0.6	0.522	0.544	0.565	0.587	5.7	4.959	4.981	5.002	5.024
0.7	0.609	0.631	0.652	0.674	5.8	5.046	5.068	5.089	5.111
0.8	0.696	0.718	0.739	0.761	5.9	5.133	5.155	5.176	5.198
0.9	0.783	0.805	0.826	0.848	6.0	5.220	5.242	5.263	5.285
1.0	0.870	0.892	0.913	0.935	6.1	5.307	5.329	5.350	5.372
1.1	0.957	0.979	1.000	1.022	6.2	5.394	5.416	5.437	5.459
1.2	1.044	1.066	1.087	1.109	6.3	5.481	5.503	5.524	5.546
1.3	1.131	1.153	1.174	1.196	6.4	5.568	5.590	5.611	5.633
1.4	1.218	1.240	1.261	1.283	6.5	5.655	5.677	5.698	5.720
1.5	1.305	1.327	1.348	1.370	6.6	5.742	5.764	5.785	5.807
1.6	1.392	1.414	1.435	1.457	6.7	5.829	5.851	5.872	5.894
1.7	1.479	1.501	1.522	1.544	6.8	5.916	5.938	5.959	5.981
1.8	1.566	1.588	1.609	1.631	6.9	6.003	6.025	6.046	6.068
1.9	1.653	1.675	1.696	1.718	7.0	6.090	6.112	6.133	6.155
2.0	1.740	1.762	1.783	1.805	7.1	6.177	6.199	6.220	6.242
2.1	1.827	1.849	1.870	1.892	7.2	6.264	6.286	6.307	6.329
2.2	1.914	1.936	1.957	1.979	7.3	6.351	6.373	6.394	6.416
2.3	2.001	2.023	2.044	2.066	7.4	6.438	6.460	6.481	6.503
2.4	2.088	2.110	2.131	2.153	7.5	6.525	6.547	6.568	6.590
2.5	2.175	2.197	2.218	2.240	7.6	6.612	6.634	6.655	6.677
2.6	2.262	2.284	2.305	2.327	7.7	6.699	6.721	6.742	6.764
2.7	2.349	2.371	2.392	2.414	7.8	6.786	6.808	6.829	6.851
2.8	2.436	2.458	2.479	2.501	7.9	6.873	6.895	6.916	6.938
2.9	2.523	2.545	2.566	2.588	8.0	6.960	6.982	7.003	7.025
3.0	2.610	2.632	2.653	2.675	8.1	7.047	7.069	7.090	7.112
3.1	2.697	2.719	2.740	2.762	8.2	7.134	7.156	7.177	7.199
3.2	2.784	2.806	2.827	2.849	8.3	7.221	7.243	7.264	7.286
3.3	2.871	2.893	2.914	2.936	8.4	7.308	7.330	7.351	7.373
3.4	2.958	2.980	3.001	3.023	8.5	7.395	7.417	7.438	7.460
3.5	3.045	3.067	3.088	3.110	8.6	7.482	7.504	7.525	7.547
3.6	3.132	3.154	3.175	3.197	8.7	7.569	7.591	7.612	7.634
3.7	3.219	3.241	3.262	3.284	8.8	7.656	7.678	7.699	7.721
3.8	3.306	3.328	3.349	3.371	8.9	7.743	7.765	7.786	7.808
3.9	3.393	3.415	3.436	3.458	9.0	7.830	7.852	7.873	7.895
4.0	3.480	3.502	3.523	3.545	9.1	7.917	7.939	7.960	7.982
4.1	3.567	3.589	3.610	3.632	9.2	8.004	8.026	8.047	8.069
4.2	3.654	3.676	3.697	3.719	9.3	8.091	8.113	8.134	8.156
4.3	3.741	3.763	3.784	3.806	9.4	8.178	8.200	8.221	8.243
4.4	3.828	3.850	3.871	3.893	9.5	8.265	8.287	8.308	8.330
4.5	3.915	3.937	3.958	3.980	9.6	8.352	8.374	8.395	8.417
4.6	4.002	4.024	4.045	4.067	9.7	8.439	8.461	8.482	8.504
4.7	4.089	4.111	4.132	4.154	9.8	8.526	8.548	8.569	8.591
4.8	4.176	4.198	4.219	4.241	9.9	8.613	8.635	8.656	8.678
4.9	4.263	4.285	4.306	4.328	10.0	8.700	8.722	8.743	8.765
5.0	4.350	4.372	4.393	4.415					

As regards the accuracy of the work done by this machine, we would say, that it compares very favorably with the results by Adam's method, as is shown by the table of comparative analyses. Where proper care is used in selecting the tubes and having them of uniform bore and carefully calibrated and graduated, results have been secured by us which we consider equally as reliable as those secured by the gravimetric method. By making the neck of the tube narrower and thereby enlarging the scale, or by using a magnifying glass with the ordinary tubes, readings can be made by a little practice to the one-fourth of a division, and by use of the table prepared by B. H. Hite, of this Station, readings corresponding closely with those secured by the most exact processes of analyses have been obtained. The most serious difficulty to contend with in the use of this machine is the calibration and graduation of the tubes. It gives somewhat higher results in our hands than does the Babcock process and is more rapid. The expense is less than half a cent per test. The labor of turning the machine is much lighter than with the Babcock, and taking it all in all, we hold this method of analysis of milk in very high esteem.

Comparative Tests of Butter Milk and Cream by Different Methods.

BY B. H. HITE.

SAMPLE BUTTER-MILK.	Adams....	Average ...	Beimling.	Average...	Babcock...	Average ...	Soxhlet ...	Average ...	Cochran ...	Average ...
No 1	0.712 0.628	0 67	0.261 0 261 0.261	0.261	0.20 0.20 0 20 0.25 0.175	0,205				
No 2	0.708 0 738	0.723	0.391 0.348 0 391	0.377	0 3 0 25	0,27				
No 3	0 982 0.995	0.988	0.826 0.783 0.826 0.826	0.815	0.2 0.2 0.2 0 2 0.2	0,2				
No 4	0 674 0.658	0.666	0.261 0.239 0.239 0.261 0 261 0 239	0.250	0 10 0 05	0.075			0.2 0.2 0.2	0.2
No 1 Cream. Diluted 1-4	5.534	5 534	5 590 5 596 5 481	5 556	5 5 5.5 5.5	5.5				
No 2, Cream Diluted 1-4	5.42 5.30	5 36	5 394 5.307	5.35	5 3 5 3 5.3 5 3 5 3	5.3				
No 3, Cream Diluted 1-9	4.746 4.628	4 687	4.393 4.350 4.263	4.335	4 3 4.3 4 3 4.3 4.3	4.3				
No 4, Cream Diluted 1-6	3.836 3.752	3 794	3.610 3 632 3.654 3 632	3 632	3 25 3.20 3.20 3.25 3.20	3 22				
No 5, Cream Diluted 1-6	4 508 4.498	4.503	4.306 4.263 4 306 4.263	4 284	4.0 4.0 4.0 4.0 4.0	4 0	4.18 4.17	4.175	3.6 4.3 4.25	3.6 4.27
No 6, Cream Diluted 1-6	4.086	4.086	4.132 4.132 4.132 4.089 4.132	4 123	3 85 3 80 3.80	3 82				

Comparative Tests of Milk by Different Methods.—(Continued.)

BY B. H. HITE.

SAMPLE WHOLE MILK.	Adams	Average ...	Beimling..	Average ...	Babcock ...	Average ...	Sxohlet....	Average ...	Cochran...	Average ...
No 1	4.69 4.71	4.70	4.698 4.698 4.741	4.712						
No 2	5.49 5 49	5.49	5.35	5.35						
No 3	5.11 5.09	5.10	4.915	4.915						
No 4	4 69	4.69	4.35	4.35						
No 5	5.05	5.05	5.22	5 22						
No 6	5.058 5.072 5,078	5.069	5.048 5.002 5 002	4.999						
No 7			5.002 4.981 4.959							
No 8 No 9.	4 904 4 928	4,916	4.872 4 915 4.915 4.915 4.959 4 872	4.908						
No 10	5 082 5 066 5.135	5.094	4.959 4.981 4 959	4.966	4.7 4.7 4.7 4.7	4.7	4.98 4.98	4 98	4 3 4.3	4.3
No 11	5 182 5.168	5.175	5.002 5.046 5 046	5.031	4.7 4.849 4.949	4.84	4.97 4.96	4.96	4.5 4.5	4.5
No 12	5.086 5 182	5.134	5 002 5.087 5.068 5.046	5.051	5 0 4.95 5.0 5.0	5 0	5.00	5.00	5.15	5.15
SAMPLE SKIM-MILK.										
No 1	0.546 0 558	0 552	0 522 0.565	0.543	0 2 0.2 0 1 0.2 0 1	0.16				
No 2	02.74	0.274	0.348 0.370 0 348	0.355	0.10 0,07 0.10 0.10	0.10				
No 3	0.768 0 754	0.761	0.522 0.522 0.522	0.522	0.3 0.3 0.3 0.3 0.3	0.3				
No 4	0.776 0.788	0.782	0.500 0.478 0.478	0.485	0.3 0.3 0.3	0.3				
No 5	0.688 0.692	0.690	0.587 0.587 0.565 0.565 0.565	0.574	0.1 0.1 0.2	0.13			0.5 0.5 0.5	0.5
No 6	0.700 0.722	0.711	0.522 0.522 0 530 0.522 0.530 0 53	0.526	0.05 0,05 0.05	0.05	1.19	1.19	0.4 0.4	0.4
No 7	0 700 0.728	0.714	0.631 0.652 0.652	0.645	0.1 0.2	0.15	0.83	0.83		

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OF THE

WEST VIRGINIA

Agricultural Experiment Station

MORGANTOWN, W. VA.

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1. FARM AND GARDEN INSECTS.

AND EXPERIMENTS WITH REMEDIES.

2. NOTES OF THE SEASON.

—BY—

A. D. HOPKINS.

ENTOMOLOGIST.

JOHN A. MYERS, Ph. D.

Director

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1. FARM AND GARDEN INSECTS.

2. NOTES OF THE SEASON.

A. D. HOPKINS.

In assuming the duties with which I have been charged the investigation of injurious and beneficial insects, and in making a collection of those found in the State, I do so with a conviction of the great importancc of such studies in promoting the agricultural interests of the State.

Recognizing the importance of a full reference collection as one of the first requisites for doing good work in this new line of research undertaken by the Station, I have devoted considerable time to collecting specimens, which are being preserved in alcohol and papers until the winter months, when they will be properly mounted, determined, and arranged in cases, which are now being prepared for their reception.

Special investigations and experiments have been conducted as follows: Experiments with remedies for the Cabbage Flea Beetle, Plum Curculio, Sheep Ticks, House Flies and Currant Worm. Special investigations on a raspberry insect, Locust tree insects and the desrtuction of the spruce forests.

Between the 2nd and 26th of July a trip was made through a portion of the State, in company with the Botanist, for the purpose of making collections, and to find out if possible, from personal observations, the agricultural conditions of our State, and the wants of the farmer in our respective departments. The trip was very successful and satisfactory in both respects. A large and valuable addition was made to the collections, and the knowledge gained will aid us very materially in directing our work where it will do the most good.

It is my intention to continue to add material to the collection whenever opportunity offers, and when I am not otherwise engaged, until a reasonably complete reference collection of the injurious, beneficial and other insects of the State is made. In addition to a study collection, I desire to form an exhibit collection to illustrate the different orders and families of insects, their wonderful transformations and modes of attack, their parasites and natural enemies, their remarkable instincts, and the provisions of nature in making

the conditions favorable for their existence. In this exhibit collection, only material of economic interest will be placed; the object being to interest the farmer in the importance of this branch of study, and thus gain the benefit of their observations and their indispensable aid in suppressing the insect pests of the State. I hope to be able to adopt a system of correspondence with farmers and others in different sections of the State, that I may be informed at as early a date as possible as to the appearance of injurious insects, and the amount of damage they may be doing to crops and forest trees, and when the amount of damage is known to be of sufficient magnitude to warrant my going into the region effected for the purpose of making special investigations of the insects, their habits and natural enemies, experiment with insecticides, and give instructions in the application of remedies, I shall do so, believing that in this way the most valuable results may be obtained in this department.

I shall continue my investigations and experiments on cabbage, locust tree and spruce tree insects, taking up one at a time in the proper season, continuing from year to year if necessary, and will give the result of my original observations and experiments in special bulletins for each investigation, so illustrated and described that the farmer will readily recognize the injurious insects and their natural enemies in their different stages and transformation, and know when and how to apply the proper remedy to obtain the best results.

In my investigations, special attention will be given to the parasites and natural enemies of injurious insects, with reference to their habits, protection, encouragement, and introduction from one locality to another. In the case of wide-spread destruction of forest trees and like ravages, this seems to be the only practicable remedy to be thought of.

My reports of investigations will be addressed to the farmer and general reader, avoiding as far as possible technical terms and descriptions.

"By the census of 1880, we find that the aggregate loss from insects in the United States equals $200,000,000 a year, while good authority places the loss one-half higher." The loss, therefore, from their depredations in West Virginia is not less than a half million dollars each year, or at least as much as the total annual tax collected in the State; a loss, which in the present state of agricultural depression, is deeply felt by those depending upon the products of the farm.

"There are over 320,000 known and described species of insects in the world; over 25 000 of them being in the United States; of which 7,000 to 8,000 are pests." It is, therefore, safe to estimate that there are over 20,000 known and unknown species of injurious and beneficial insects in West Virginia.

We realize the importance of a better knowledge of our insect enemies and friends when we consider that the life history of only a few of our commonest insects is well known, that without a knowl-

edge of the complete life history of an injurious insect in all its transformations, we can not successfully combat it; and that without a knowledge of the habits of an insect and its natural enemies, we may often do more harm than good in recommending or applying remedies.

The study of the habits of a single insect through its transformations; the egg, how, when and where depositied; the larva or worm; its habits of feeding; its natural enemies; when and where it changes to the pupa; duration of the pupa state; when the perfect insect emerges; how it passes the winter and its habits up to the time of depositing its eggs "often involve earnest, long, and patient study and the united labors of individuals extending over a series of years." When we consider the many thousands of beneficial and injurious insects of which the life history is not known, we realize the magnitude of this field of investigation, and the need of earnest workers in every State and intelligent observers on every farm, all working together for the advancement of knowledge in economic Entomology.

Less than a century ago, the study of insects was ridiculed by nearly every one, and even yet, it is ridiculed by many of those whom it would benefit most. The study has, however, assumed great importance within the last few years in its direct application to advancing the agricultural interests of the country. With the Division of Entomology at Washington, the U. S. Entomological Commission sustained by liberal appropriation, the State Entomologists employed by a number of the States, and the Experiment Station workers in Entomology of which there are now about thirty, we may look for the most rapid progress, and valuable results within the next few years.

FARM AND GARDEN INSECTS.

Having been supplied with a complete outfit for testing and experimenting with remedies, I have made such experiments and tests as the conditions would justify.

For the benefit of those who are not acquainted with the transformations and habits of insects, I will give an outline history of each insect on which remedies have been tried. The common name will be given first, followed by the technical name.

THE STRIPED FLEA BEETLE OR CABBAGE FLEA.

(*Phyllotreta Vittata Fab.*)

This well known garden pest appears early in the spring, destroying cabbage, radish and turnip plants before the second leaf is formed, and feeding on the leaves of the same through the summer. The beetles deposit their eggs in the stem and roots of cabbage and radish plants, the eggs hatch into minute worms which feed upon the roots and stem causing the plant to wither and die as if

scorched by the sun. Frequently as many or more plants are killed by the worms or larvæ as is destroyed by the beetle.

Great loss is sustained by farmers along the Ohio river from the ravages of this insect where millions of plants are grown in open fields.

On April 23rd, this beetle made its appearance on my cabbage and radish plants. I at once commenced a series of tests and experiments with remedies, and up to May 13th, I made two or three applications of each of twelve different remedies upon a plant, the rows of which were divided into sections, part of them being left as checks.

Remedy No. 1. (*Original.*)

½ gallon of water. Two table-spoons soft soap. 1 table-spoonful pyrethrum. 1 table-spoon carbolic acid. 2 table-spoons tabacco dust. Applied April 23rd, with garden syringe, ½ of the mixture to 30 ft. row of radish plants badly infested. In a short time the beetles were found lying on their backs apparently dead. Ten beetles thus affected taken in a bottle revived within an hour. Beetles did not feed on the treated plants until the remedy was washed off by rain.

Remedy No. 2. (*Original*).

Lime 1 pint.
Ashes 1 pint.
Plaster ½ pint.
Tobacco dust 6 table spoons.
Carbolic acid 1 table spoon.

1-2 of this mixture was applied to 30 ft. row of cabbage plants. 3 ft. left without remedy. Rained directly after making application. April 25th, no difference observed in treated and untreated. This would probably be a good application to make every morning in dry weather. Three more applications were made between April 23rd and May 13th. It rained directly after each application. Result same as above.

Remedy No. 3.

Composted hog manure dusted around radish plants. This had the effect of making a rapid growth of plants thus preventing injuring from beetles to some extent.

Remedy No. 4. (*Original.*)

2 qts. water.
1 handful tobacco dust.
1 tablespoon carbolic acid.
1 teaspoon paris green.

1 pint soft soap.

Applied full strength killed the plants.

Diluted ¼ killed the plants.

Diluted ½ scorched them.

Diluted ¾ had the effect of keeping beetles away until the remedy was washed off by rain.

Remedy No. 5. (Original.)

Saw-dust impregnated with natural heavy West Virginia oil.

Saw-dust ½ gallon. Oil ½ pint.

Applied 1 qt. of mixture to 30 ft. row of cabbage plants. This proved a good preventive for a few days.

Remedy No. 6. (Original.)

Saw dust 1 qt.

Turpentine 3 tablespoons.

Carbolic acid 1 tablespoon.

Applied to 30 ft. row of cabbage.

More beetles were found on this row than on No. 5, but not so many as on check rows.

Remedy No. 7.

Applied 1 pint of soot from wood fire chimney to 15 ft. row of cabbage plants. Two applications, between May 8th and 13th. Rained after making each application. Result: Beetles found on treated and untreated alike.

Remedy No. 8.

Wood ashes, 1 pt. Applied to 15 ft. row radish and 15 ft. row cabbage plants. Condition and result the same as No. 7.

Remedy No. 9.

Tobacco dust, 1 tablespoon applied to 15 ft. row of cabbage plants. Condition and result same as No. 7.

Remedy No. 10.

Poultry manure, 1 qt. applied to 15 ft. row of cabbage plants. The plants grew better, but the result as to injury from beetles about the same as No. 7.

Remedy No. 11.

Pyrethrum (or insect powder) 1 tablespoon applied to 15 ft. row of cabbage plants covered with beetles; this seemed to kill them. Nine beetles, howevor, taken in a bottle revived within an hour.

Remedy No. 12.

Pulverized dry dirt dusted over plants. This had no effect again on account of rain.

Summary.

On account of frequent rains during the time of making tests, it was impossible to arrive at definite conclusions. Owing to the fact that frequent rains are favorable to the growth of cabbage and radish plants and unfavorable for the life habits of the flea beetle, the untreated or check rows fared almost as well as those that were treated. The experiments proved, however, that liquid applications like Nos. 1 and 4, and disagreeable odors like 5 and 6, would probably be the best remedies to use in wet weather. Nos. 2, 7, 8, 9, 11 and 12 applied in the morning while the plants are wet with dew, in dry weather would probably be good remedies. The liquid applications should always be applied in the evening.

The most favorable conditions for the life habits of the Flea Beetle is a bed of cabbage plants in an exposed dry and sunny spot, disturned only occasionally by rain and the cultivator. To successfully combat the pests, therefore, we must reverse these conditions as far as possible by selecting damp shady spot for the plants, cultivating frequently and watering often if necessary.

SHEEP TICK.

(*Melophagus Ovinus Linn.*)

This well known sheep parasite is found in the wool at all times in the year. According to Packard, (Common Insects page 85). "The young are developed in the body of the parent insect, and instead of an egg, a pupa case is deposited containing a young tick. These pupa cases are found in the wool resembling brown seeds. Each female produces but two or three young," therefore, they do not increase readily, When very numerous they cause the sheep to fail in flesh. In Spring before and after the sheep are shorn, they leave the old ones and attack the lambs, checking their growth and preventing their fattening, causing great loss to the grower of mutton lambs.

On April 25th, I applied the following original mixture as a remedy for ticks on lambs. Salt 8 table spoons, Tobacco dust 8 table spoons, Sulphur 4 table spoons, Pyrethrum 2 table spoons. Mixed and applied dry to twenty lambs when wet with dew. The wool opened and the mixture sprinkled and thoroughly rubbed in with the hand.

On April 26th, I examined the lambs and found nearly every tick dead. This mixture should be applied to the sheep in the fall and spring and to the lambs when one to three months old.

THE PLUM CURCULIO.

Conotrachelus Nenuphar Herbs.

This small, rough, grayish beetle is about .15 of an inch long and feeds on the leaves and green fruit of the plum, apricot, peach, cherry apple and quince. It deposits eggs in the young green fruit in which the larva or worm develops, causing the fruit to fall off, "when the larva emerges and enters the ground, where it changes to the beetle in about six weeks." "Coming from the ground it hides in some secluded spot under chips and bark until the following spring; when it comes forth to again feed and deposit its eggs, appearing at first only at night. Later it may be found on cloudy days on the fruit and twigs. It is very timid and will curl up and fall off the tree when alarmed. Its habit of feeding on the fruit and leaves enables us to kill some of them by spraying the trees with poison liquids, and their falling from the tree when alarmed enables us to collect and destroy them by jarring them off on sheets spread under the tree. To prevent injury to the tree when jarring, a branch should be cut off leaving a stub on which to strike with a mallet or hammer. This jarring process should be commenced about the time the blossom falls and continued until about the first of July. The jarring should always be done late in the evening or early in the morning. When, however, there are a number of trees sufficient to justify the purchase of a spraying outfit, it may be better to spray the trees with a poison solution of Paris Green and London Purple. If the Plums or Cherries are affected with mildew or rot it is well, perhaps, to add a mixture of copperas and lime or soda carbonate to the poison solution.

The proper poison mixture is about 1/4 lb. of London Purple to 50 gallons of water· to which may be added for the mildew or rot 4 lbs of sulphate of copper and 5 lbs. of soda carbonate.

Nearly all the fruit in this section was killed by late frosts. This, with the unusual wet weather, made an unfavorable season for making tests or experiments with remedies for the curculio. I had, however, a few cherry trees that were in full bloom, and on May 15th, just after the blossom fell from the tree, I applied about ten gallons of the above mixture on a large cherry tree on which the cherries had been badly affected in previous years by the curculio and mildew. On May 25th, I examined the cherries on the sprayed and unsprayed trees, finding many stung cherries on the unsprayed.* but none on the one that was sprayed. On May 28th, the cherries commenced to rot and the rose bugs were observed eating the cherries on the treated and untreated alike. A few cherries on the sprayed trees were stung by the curculio. On June 2nd I made another application of the same mixture to the same tree. The rose bugs continued to eat the cherries; but no further attack of the cur-

*The nearest unsprayed cherry tree to the one that was sprayed was about 100 yards.

culio or rot could be found. The cherries on the unsprayed trees were so badly affected by the curculio, rose beetle and an Hemipterous insect, that scarcely a cherry remained on the trees to ripen.

The sprayed tree remained full of cherries until he first ones began to turn red, when over two-thirds of them fell off covering the ground with the fallen fruit. No worms could be found in the fallen fruit, and the cherries that remained on the tree were also free of worms. The fallen fruit showed evidence of punctures of the Hemipterous bug, which probably caused them to fall.

While the above experiment was incomplete, it was sufficient to prove that it would probably pay well to apply the mixture to cherry trees subject to the attack of the curculio or rot.

THE CODLING MOTH.

(*Corpocapsa Pomonella Linn.*)

This insect was imported from Europe about the year 1800 and is now found wherever apples are grown in North America, causing an immense loss to fruit growers. It is a very small chocolate colored moth, appearing in the spring when the apples are in bloom, depositing their eggs in the blossom end of the fruit when about the size of peas. In about a week, the eggs hatch into a small pinkish worm, which bores into the apple and feeds around the core until it arrives at maturity, when it escapes from the apple either before or after it falls from the tree, after which when they construct their pupa cases or cocoons under the rough bark of the tree, where they change to the pupa, which remains in the cocoon about two weeks, when the moth emerges to again deposit eggs in the more mature fruit late in July or early in August, this being the second brood of worms; the first brood causing the young apples to fall from the tree, the second brood spoiling the mature apples for market and making them "wormy" and imperfect. The worms are carried to the cellar in the apples where they escape and spin their cocoons in which the worms or larvas spend the winter changing to the pupa early in the spring from which the moth soon emerges.

Two parasites of this insect were bred and described by Prof. Riley. These parasites deposit their eggs in the worm, which hatch into small grubs and devour their host.

There are also birds and other insects which attack and feed upon the worms after they escape from the apple.

Remedies.

By keeping sheep or hogs in the orchard to eat the fallen fruit, many of the worms may be destroyed. The best remedy however, is to spray the trees with a poisoned liquid during the time the moths are dositing their eggs. A very small amount of this poisoned liquid catching in the blossom end of the young apples is sufficient to kill the young worms when they hatch and commence to feed.

Paris Green, or London Purle is used for this purpose. Prof. Cooke of Michigan who has tried many experiments with this remedy with excellent results, recommends 1 pound of the posion to 200 gallons of water.

To prove that no bad effect would result from stock eating the grass under a tree after it had been sprayed with this poisonous liquid, he cut the grass under a tree thus sprayed and fed it to his horse; this did not even make the animal sick. By analysis it has also been found that there is not a sufficient amount of poison adhering to the fruit or grass to injure animals.

On May 14th, June 2nd and 13th, I sprayed four apple-trees, using the same mixture with which I sprayed the cherry tree. The rose beetles were very plentiful on the trees, eating the fruit at the second spraying; but the liquid did not seem to have much effect on them. They continued to eat the apples on the sprayed and unsprayed trees alike.

On account of other pressing duties and absence from home, I could not make a thorough examination of the fruit when it ripened; but as far as I could judge from a hasty examination, the fruit was much less affected by worms or rot on the sprayed trees than on the unsprayed. I hope to make farther and more complete tests next spring.

In applying the remedies upon both the cherry and apple trees, the "Perfect Spraying Outfit" was used, which is a hand force pump attached to a barrel containing the mixture. It has ten feet of discharge hose with a graduated spray nozzle attached. An arrangement is also attached for agitating the mixture in the barrel while spraying. With this outfit placed in a wagon, the hose tied to a long pole, and an assistant to drive the pump, every part of the largest trees may be thoroughly sprayed.

THE IMPORTED CURRANT WORM.

(*Nematus Ventricosus Klug.*)

This is a very common insect throughout the State of which much complaint has been made the past summer. It is a fly about the size of a house-fly, but belonging to a different order of insects. They appear early in spring and deposit their eggs on the veins on the under side of the leaf in regular rows. These hatch into the now familiar worms in about four days. These continue to feed about eight days, after which they leave the bush and seek a sheltered spot, or enter the ground, where they spin their cocoons in which they change to the pupa, remaining thus about 13 days, when the fly emerges to deposit eggs for another brood of worms, which, after coming to maturity pass the winter in their cocoons, the flies appearing again in the spring.

Prof. Linter, of New York, discovered a parasite which attacks the eggs, causing them to turn brown. In other localities an ichneumon parasite attacks the worm, while the soldier bug (one of

the stink bugs) "destroys the lava by thrusting its beak into the victim and sucking it until it shrivels up and dies.

On May 20th, powdered white helebore applied dry with a bellows to gooseberry bushes infested with the worms proved to be an excellent remedy, killing nearly every worm the first application. This remedy applied dry or in solution of about an ounce to two gallons of water, is probably the best remedy known.

Rose slugs, cherry and pear slugs belonging to the same family as the currant or gooseberry worm—may be successfully destroyed by the same remedy.

THE HOUSE FLY.

(*Musca domestica Lin.*)

This is our commonest household pest, familiar to every one as they see them; but a mystery to most people as to where they come from. Like all other insects, it is first an egg, then a worm, larva or maggot, then a pupa or inactive form from which the fly emerges. During the first warm days of spring, this fly comes forth from its winter sleep, having passed that season either in its perfect state or as a pupa; they then commence to deposit their eggs in stable manure, and decaying vegetable substanc s. The eggs hatch in about twenty-four hours into a little m ggot, which feeds upon these substances coming to maturity in about a week, when they accumulate in great numbers in a dry spot and change to the pupa. When they resemble little, red eggs, the size of small wheat grains. They remain thus about a weak, when the perfect flies emerge to again deposit their eggs, in this manner there is a number, probably a dozen broods within a year.

They are sometimes attacked by a disease called the "Fly Cholera," a vegetable parasite or fungus, which destroys great numbers. When thus affected, they may be found attached to the wall or window pane, surrounded with a white halo of the spores. An insect parasite also attacks them in their larval state, living within their host until after the fly larva changes to the pupa, when, instead of the fly emerging, a minute gnat or chalcid fly will come forth. They also have a great many other insect and animal enemies.

Perhaps the best preventative against this pest is to keep everything about the house and outbuildings scrupulously clean, not allowing manure of any kind, or decaying vegetable matter, to remain in once place longer than ten days during the spring and summer months. Such matter should be scattered out on fields and gardens where it will do the most good. A compost heap proves a hot bed for flies unless sufficient lime or plaster is added to kill the larvæ. Beneath stable floors is also a nursery for these little pests.

During the summer, I made frequent tests with insect powder (pyrethrum), blown freely in the air of a closed room with the Woodson Insect Powder Bellows, which proved this method to be one of the best remedies for stupefying the flies. When thoroughly done,

(if the powder has not lost its strength), the flies may be swept up and burned within an hour after the powder is used, if allowed to remain longer many of them will recover.

COLLECTING TRIP NOTES.

Between July 2d and 26th, 1890, a journey was made by team and wagon throughout eleven counties of the State, in company with the Botanist of the Station; the route being from Parkersburg up the Little Kanawha River, through Wood, Wirt, Calhoun and Gilmer counties, thence on the Parkersburg and Staunton pike through Lewis and Upshur counties over Rich Mountain to Beverly, and up the Valley River through Randolph county to Valley Head; thence over Point and Buffalo Bull Mountains, down Elk River to Addison; thence over Elk Mountain through Webster county into Nicholas county; thence down the Gauley and Big Kanawha River through Fayette and Kanawha counties to Charleston; thence by the Charleston and Parkersburg pike through Kanawha, Jackson and Wood counties to Parkersburg, being a distance of 376 miles. Copious notes were taken of observations all along the route of which the following is a summary:

COLORADO POTATO BEETLE.

This beetle which has in past years been so destructive to the potato crop in this State, was observed to be doing very little damage all along the route, and it was reported that within the last year or two this insect seemed to be disappearing. This, no doubt, is caused by the increasing number of its natural enemies, which were found quite plentiful among the vines. Prominent among these were the lady birds, (little red bugs or beetles with black spots), a number of species of which were observed devouring the eggs and young larvæ of the pototo beetle.

CURRANT OR GOOSEBERRY WORM.

The destructive work of this insect was noted through all the counties except portions of Gilmer, Fayette, Kanawha and Jackson counties.

THE WHITE GRUB.

This pest, the larva of the May beetle (which is so plentiful at night, during May, feeding on the leaves of fruit and forest trees), was reported in every county passed through as doing great damage to grain and grass crops. In the Tygart's Valley in Randolph and through portions of Webster and Nicholas counties, their damaging effect upon the corn was very noticeable.

WIRE WORMS.

These are the larvæ of several species of snapping or click beetles, and like the White Grub are found to be doing immense damage to corn crops, especially in the low lands of Tygart's Valley and Welch Glades. One farmer near Beverly reported that he had replanted his corn three times and the wire worms ate it up each time before it came up. He then soaked his corn in tar water, when he got a partial "stand," but too late to make a crop. It was also reported here that the worms were much worse on corn where hay and straw had been previously fed out on the land. Another farmer near the head of the valley had tried Buckeye Phosphate in the hill as a remedy for Wire and Grub Worms on corn; but the results were not satisfactory.

The Wire and Grub Worms are without doubt among the worst insect pests the farmers of this State have to contend with. Hidden as they are beneath the surface of the ground and feeding on the roots of the grain and grasses, and on the roots of nearly every kind of vegetation. I have frequently observed in my practical experience on the farm that an application of different kinds of stable manure and plowed under on land infested by these insects has proven doubly beneficial in stimulating the crop and repelling or killing the worms. It is, therefore, my intention to visit the worst infested districts next spring for the purpose of studying these insects, and to conduct a series of experiments with different kinds of fertilizers to ascertain their value as insecticides, and I would suggest that farmers generally note carefully the effect on these insects, of different kinds of fertilizers; especially stable manure plowed under for corn, and report results to the Station.

THE CABBAGE WORM.

Of the White Butterfly (Pieris rapae) was reported all along the route as not doing as much damage to the cabbage as they had in former years, and the Butterfly was noted as being rare.

A new Cabbage Worm, which is probably the larvae of the Cabbage Pionea (*Pionea remasalis*) was reported and observed to be doing considerable damage to cabbage near Charleston and Parkersburg. It has since been observed at Morgantown, and was recently sent to me from near Amenia, Washington county, O. This is a southern insect and is probably being introduced here in southern cabbage. I find, however, that a parasite is destroying this insect in great numbers, which will probably prevent it from becoming a serious pest.

THE APPLE-TREE TENT-CATERPILLAR.

The webs of this insect were observed plentiful in apple trees in portions of Wood and Upshur counties, and occasionally at points in other counties passed through; the trees having in places been

defoliated by the caterpillar. The eggs from which these caterpillars hatch are deposited in July by a moth or "miller" in groups of two or three hundred, on small twigs, resembling black knots. These may, without much diffiulty, be found and destroyed during the winter, and thus prevent the caterpillar from appearing in the spring.

THE STOCK-BORER OR "HEART-WORM."

This is a brown or black striped worm which was frequently observed feeding in the heart of young corn, in the stalks of iron weed, thistle, rag weed and young blackberry briars; in fact they were found in nearly every kind of weed and plant having a pithy stalk. They were found to be doing considerable damage to corn in Randolph and Webster counties.

THE GRAIN PLANT-LOUSE

Was generally complained of, and probably did considerable damage to wheat and oats early in the season; the latter crop being almost a failure in all the counties passed through. A number of parasites were found attacking this insect, which no doubt prevented a total destruction of the wheat and oats crop.

THE PEACH TREE BORER.

Was found to be generally destructive to neglected peach trees. Fresh wood ashes placed around the trees in May of each year has been found an excellent remedy against the attack of this insect.

THE APPLE TREE BORER.

This insect was found to be doing much damage to apple trees in Upshur county, near Buckhannon. One of the best remedies for this insect, perhaps, is to place fresh wood ashes around the roots of the trees in May and July of each year and hang rags or pieces of old carpet satuated with soft soap in the forks of the trees. This, like the above remedy for the Peach Tree borer is, however, only successful as a preventative. After the Grubs are once lodged within the wood, they must be either cut out with a knife or killed by inserting a wire into their burrows.

TOBACCO INSECTS.

Through the "Lime Stone Hill" region in Jackson and Wood Counties, where tobacco is one of the principal crops grown, the insect complained of was the Tobacco Worm, which had been giving unusual trouble.

There is a parasite attacking this worm, and if the worms thus attacked were left to breed them, the insect would probably soon

disappear without much effort on the part of the tobacco grower. The worms thus affected may be known by their unhealthy appearance and the great number of little white cocoons on their backs, each one of which contains a parasite.

SPRUCE INSECTS.

While passing through Randolph County, we first learned of the destruction of the Spruce timber in Cheat Mountains, the cause of which no one seemed to know. It was reported that hundreds of acres of the timber was continually dying and that the trouble was constantly increasing. When we learned of the immense extent of the forests covering some five hundred thousand acres, and that it was probably threatened with total destruction, possibly by disease or insects, we decided that on returning to the Station, we would urge the importance of a special trip to this region for the purpose of investigating the trouble. Accordingly a trip was made into this region the last of August, an account of which will follow.

A NEW WHEAT INSECT.

A new wheat insect was reported near Elizabeth in Wirt County, operating in the stalks, causing them to fall or lodge before the grain ripens. The crop being gathered, observation on the species causing the trouble was impossible.

A NEW CORN INSECT.

A new corn insect was reported near Charleston to have done considerable damage to the crop early in the season. It was a "small white worm" or "maggot" operating near the roots of the young corn.

A new Gooseberry Bug or Beetle was reported near Mount Carmel, in Fayette County. A "small bug" had eaten all of the leaves and fruit off the bushes.

A rabbit was found in the road in Jackson County having evidently died from the effects of a parasite which, upon examination, was found in a large tumor on its neck. It has been noticed for a number of years that the rabbits in the vicinity of Kanawha Station during July and August were seriously affected from the attack of this parasite. They became so weak and emaciated that they could not run and dogs would kill great numbers of them.

A day was spent with Mr. W. H. Edwards at his home in Coalburg, Kanawha County. Mr. Edwards has spent many years in the study of the Butterflies of North America, and his work and writings have made his name familiar to Entomologists in this and other countries. The butterflies taken by me up to that time were kindly determined by him. I am also indebted to him for later determination.

The specimens taken during the trip, are all yet in alcohol and

papers, where they will necessarily remain until a cabinet is prepared and time can be had to properly mount and determine the material. A list of the species taken on this trip will appear later.

It will be seen from this report that there is a broad field for work in this Department. That this trip has pointed out lines of work in which results should yield the greatest benefit to the farmers and to the State, and that to obtain such benefit, special investigations must be made in the localities in which the greatest damage is being done by cerlain insect pests.

THE HORN FLY.

On returning to Kanawha Station on July 26th, this was observed for the first time on my cattle, and on inquiry it was found that they were annoying other cattle in the neighborhood, which was creating considerable comment as being something new. Prof. John B. Smiths' excellent account of this fly in a special bulletin of the New Jersey Expermiment Station and in the Annual Report of the same for 1889, enabled me to recognize this insect brought over on cattle about the year 1886–1887. It was reported from near Philadelphia in 1887 and by the middle of July, 1889 it had spread nearly all over the State and southward into Virginia and northward into New Jersey.

The fly will be readily recognized where they make their appearance by their great abundance on the body and horns of the cattle. The resemble the common house fly, being abont half as large. They are blood thirsty little insects and so annoy the cattle by their bites that the cows fail in milk and other cattle fail in flesh.

On October 10th, the flies were again observed at the same place and more complaint was heard in regard to them.

On September 18th, my home was again visited, when a Jersey cow was found to have large bleeding sores on each side, exidently caused by the irritation of the flies and kept bleeding by the cow striking or rubbing the places with her horns.

According to Prof Smith, these flies breed in the fresh droppings of the cattle a new brood appearing every fifteen days. Prof.. Smith recommends as as remedy against the attack of the flies, fish oil, with a small amount of carbolic acid applied with a sponge, or X O Dust and Tobacco Dust applied to the cattle among the hair where the flies most usualy congregate.

These flies will probably appear in great numbers next season, and may do considerable damage.

I bring this matter before the farmers of the State thus early in my observations upon the fly in order that I may incite them to observe the insect, and to invite correspondence from them that may lead to a better knowledge of their distribution in this state and the amount of damage they cause.

VOL. II. NO. 3.

Bulletin No. 15.

OF THE

WEST VIRGINIA

Agricultural Experiment Station,

MORGANTOWN, W. VA.

RASPBERRY GOUTY-GALL BEETLE.

—BY—

A. D. HOPKINS,

ENTOMOLOGIST.

JOHN A. MYERS, Ph. D.

Director.

MARCH, 1891.

CHARLESTON.
MOSES W. DONNALLY, PUBLIC PRINTER.
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THE RASPBERRY GOUTY-GALL BEETLE.

OR

Red Necked Agrilus.

(*Agrilus ruficollis, Fabri.*)

The larva or grub of this beetle is injurious to cultivated raspberries, blackberries, and dewberries, killing the canes by girdling the main stems and branches, checking the natural flow of sap, and forming thick, rough places called gouty-galls.

The beetle (Fig. 4., natural size, and Fig. 7., enlarged) has blue black wing covers and beautiful copper colored neck or thorax. They appear from June until August; but usually during and after the blossom falls from the raspberry, depositing their eggs on the young cane at first near the root, later, at different points on the main stem and branches. The eggs hatch into minute worms or larvæ, which, guided by a wonderful instinct, at once commence feeding on the sap just beneath the bark; proceeding spirally upward around the cane, as shown at Fig 1., causing it to die.

When the larva has attained a certain size, it enters the woody part of the cane to the pith, through which it proceeds upwards, frequently eating through the wood to feed on the sap, (as shown at d. and e.), which is evidently its natural food. When it has proceeded in this manner from 4 to 8 inches in the cane, it excavates a cavity, or pupa case, in the pith near the woody part, in which it passes the winter in the position as shown at f. In March, it sheds its skin, and changes into a form much shorter, and is found in the position as shown at Fig. 2. During April, it sheds its skin again, changing into the pupa state as shown at Figs. 3 and 6, remaining thus until late in May, when it changes to the perfect beetle, and soon emerges from the cane, as shown at Fig. 4.

The time in which the eggs are deposited probably extends from June to August, that being the habit of other species belonging to the same family. It is evident that eggs are deposited late in the summer, from the fact that occasionly young larvæ are yet found in the galls late in March and April, and late in May I have taken a few larvæ in the pith not having formed their pupa case. It is,

EXPLANATION OF PLATE.

Fig. 1. Raspberry cane infested by Agrilus ruficollis, showing at *a*, the young larva in mine; 2, cocoons of parasites; c, where larva enters wood to pith.; d and e, where larva comes out to feed on sap, and at f, the position of the larva during winter months.

Fig. 2. Larva after shedding skin in March.

Fig. 3. Pupa in April.

Fig. 4. Perfect insect emerged.

Fig. 5. Larva; Fig. 2. enlarged.

Fig. 6. Pupa; Fig. 4. enlarged.

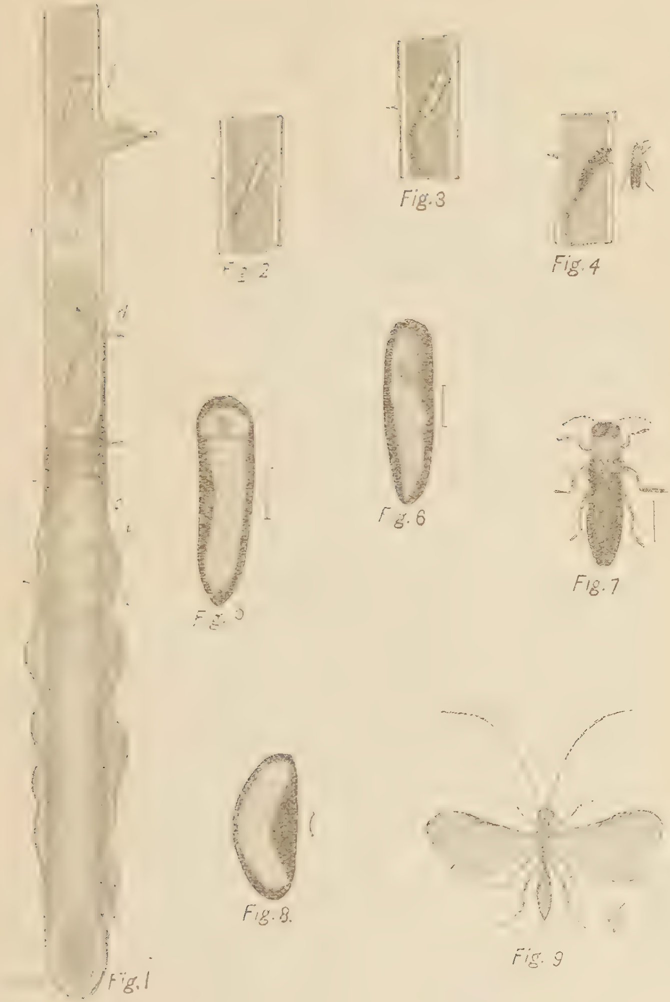
Fig. 7. Beetle; Fig. 4. enlarged.

Fig. 8. Parasite larva (enlarged) from cocoons at b, and Fig. 1.

Fig. 9. Parasite (enlarged) bred from cocoon found in mine as shown at b, Fig. 1.

Lines at the right of the enlarged figures, and the small insect at right of Fig. 9. represent the natural size.

PLATE 12.



RASPBERRY GOUTY-GALL BEETLE.

(ORIGINAL.)

therefore probable, that some of the beetles emerge late in the summer. By far the larger portion of the larvæ, however, are found early in the winter in the position shown at fig. 1, the beetle emerging in June.

The infested canes may be easily detected by an uneven swelling 1 to 4 inches long found at different points on the main stem and branches; but usually near the ground. Careful search must be made for the infested canes, which should be cut out and burned before the period of flowering, thus preventing the beetles from emerging to deposit their eggs on the young canes. All wild blackberry and dewberry briars in the neighborhood of cultivated ones should also be cut out and burned before the beetles emerge, provided in both cases, the beetles have not been attacked by parasites.

PARASITES.

When a plant or special crop is produced in one locality for a succession of years, the insects feeding upon it become abundant from the increase supply of their natural food.

Every species of insect has one or more special parasites, or other natural enemies. These also increase from the same cause, reducing the destructive insects in proportion to their own prevalence. The original parasite, are in turn attacked by other secondary parasites and natural enemies, the injurious insect being allowed again to increase, which may be claimed to be a provision of nature to preserve an equal balance of animal and vegetable life. How to best protect and foster the natural enemies of injurious insects is therefore a problem of the greatest importance in entomological work. Often by gaining a thorough knowledge of an injurious insect and its natural enemies, we may with very little effort on our part so assist nature as to prevent it from becoming a pest.

True insect parasites are minute gnats or flies called Ichneumons Chalcids and Tachinæ flies. They deposit their eggs in and on the eggs and larvæ of other species; the eggs hatching into grubs or larvæ which live within their host, "feeding upon the fatty portion of its victim, which dies from exhaustion" after the parasite larvæ have matured and emerged from its body. The parasite larva either changes to a pupa within the body of its victim, or emerges and spins a cocoon from which the perfect insect emerges in due time.

The cocoons of two species of parasites were found in raspberry and blackberry canes where the larvæ of the Agrilus have perished.

On March 11th, cocoons like those represented in Fig. 1 at b were found plentiful in the galls of the Black Cap Raspberry, scarcely a living larva of the raspberry beetle being found, although the galls were quite plentiful. On April 7th, two parasites emerged from the cocoons. Sending cocoons, larva, and a specimen of the insect to the Division of Entomology at Washington, Mr. L. O. Howard, First Assistant Entomologist who has made a special study

of parasites, kindly replied to my letter of inquiry. (Insect Life Vol. 3. Page 20) saying that "the parasite which you have reared from the Agrilus ruficollis is a new species of the genus Bracon. It is in all probability a primary parasite, as the species of this genus are reared from Coleoptera larvae." These parasites emerge from the cocoon at the side, near the end. They continued to emerge from the cocoons until June 25th, when my supply gave out. The larva of this parasite taken from a cocoon is figured at 8, very much enlarged and the perfect insect at 9.

On May 13th, I discovered another parasite cocoon in the pupa case formed by the Agrilus larva. Quite a number of these were found later, all of them in the pupa case of Agrilus, in blackberry and dewberry briars. On June 25th, the perfect insect, or (imago) emerged from one of these cocoons; the others which are being kept in a bottle are yet (Oct. 24th), in the larva state within the cocoons, the natural time for them to emerge being probably late in the season after the Agrilus larvae have formed their pupa case. This was also determaned by Mr. Howard as *Charitopus Magnificus.*

Out of 109 infested and dead blackberry canes examined on May 20th, five were found to contain the cocoons of parasite No. 1, 15 to contain cocoons of No. 2; and 26 containing living larvae and pupa of Agrilus, as follows: 13 pupa as in Fig. 3; 1 larva in the condition as in Fig. 2; 9 larvae in the condition as at *f.* in Fig. 1; 1 larva feeding in the pith; 2 larva in the galls; 67 having perished either from the sting of parasites or some other cause.

I would therefore suggest that when pruning cultivated raspberries and blackberries that the infdsted cane should be thorougly examined and if a majority of the beetle larvae have been destroyed by parasites or other causes that it would perhaps be best to not burn the infested cane ; but leave them that the parasites may again emerge to attack the Agrilus. These canes containing parasites could also be introduced into patches or localities where the beetles are not infested by them, and thus be made to assist in destroying the pest.

In localities where berries are not cultivated and "borers" are a pest, it would be well perhaps to reverse the operation, protect the beetles and destroy the parasites.

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Bulletin No. 16.

OF THE

WEST VIRGINIA

Agricultural Experiment Station

MORGANTOWN, W. VA.

PRELIMINARY INVESTIGATION OF INSECT RAVAGES.

YELLOW LOCUST.

—BY—

A. D. HOPKINS.

ENTOMOLOGIST.

JOHN A. MYERS, Ph. D.

Director

APRIL, 1891.

CHARLESTON, W. VA.
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FOREST AND SHADE TREE INSECTS-I.

Yellow Locust, (*Robinia Pseudacacia, L.*)

Preliminary Investigation of Insect Ravages.

Returning to the Station on August 7th, after an absence of about two months, I observed the locust trees all along the Baltimore & Ohio R. R., between Central Station and Morgantown peculiarly affected. The trees everywhere in the forest and field having a scorched and dead appearance.

The landscape thus marred by the dead appearance of this, one of our most valuable as well as beautiful forest and shade trees, attracted the attention of every one, and excited their wonder and curiosity as to the cause of the trouble.

Arriving at Morgantown, which seemed to be the worst affected district, I at once, by the request of the Director of the Station commenced an investigation which was continued until August 14, when I was called away to attend to other duties. This short time only enabled me to lay a foundation for a future and more thorough investigation, which the extent and increasing value of the locust timber certainly warrants, when it may be destroyed by insects within a few years, as has been done in New England and the West.

The present trouble was found to be caused by insects; and the region thus affected so far as I have since observed extends through Doddridge, Harrison and Preston Counties, from Grafton westward to near the Wetzel County line, from Fairmont through Monongalia County to the Pennsylvania line, and from Piedmont southward through Tucker, Randolph, Upshur and Lewis Counties. The trees were unaffected through Ritchie and Wood Counties, and along the Ohio River as far as was observed, the leaves being fresh and green at the time they seemed to be dying in the infested districts mentioned. This dead and scorched appearance of the locust trees at a time of year when they are noted for their beautiful green foliage was, as far as can at present be learned, first noticed in Harrison County about the year 1885, when a few scattering trees were observed to turn brown. The number of trees thus affected rapidly increased each year until every tree, bush, and sprout of this species looked as if it had been killed by fire. This trouble continued to spread until at present at least one-fifth of the State is affected.

While over forty species of insects were found to be feeding on different parts of the affected trees, one species, the Locust Hispa, appeared to be the principal cause of the trouble. The following is an account of this and other insects so far observed.

EXPLANATION OF PLATE.

LOCUST TREE INSECTS.

Fig. 1. Locust Hispa, Odontota Dorsalis.

a. Under side of foot showing peculiar formation.

b. Profile of foot showing peculiar formation.

c. Supposed egg case.

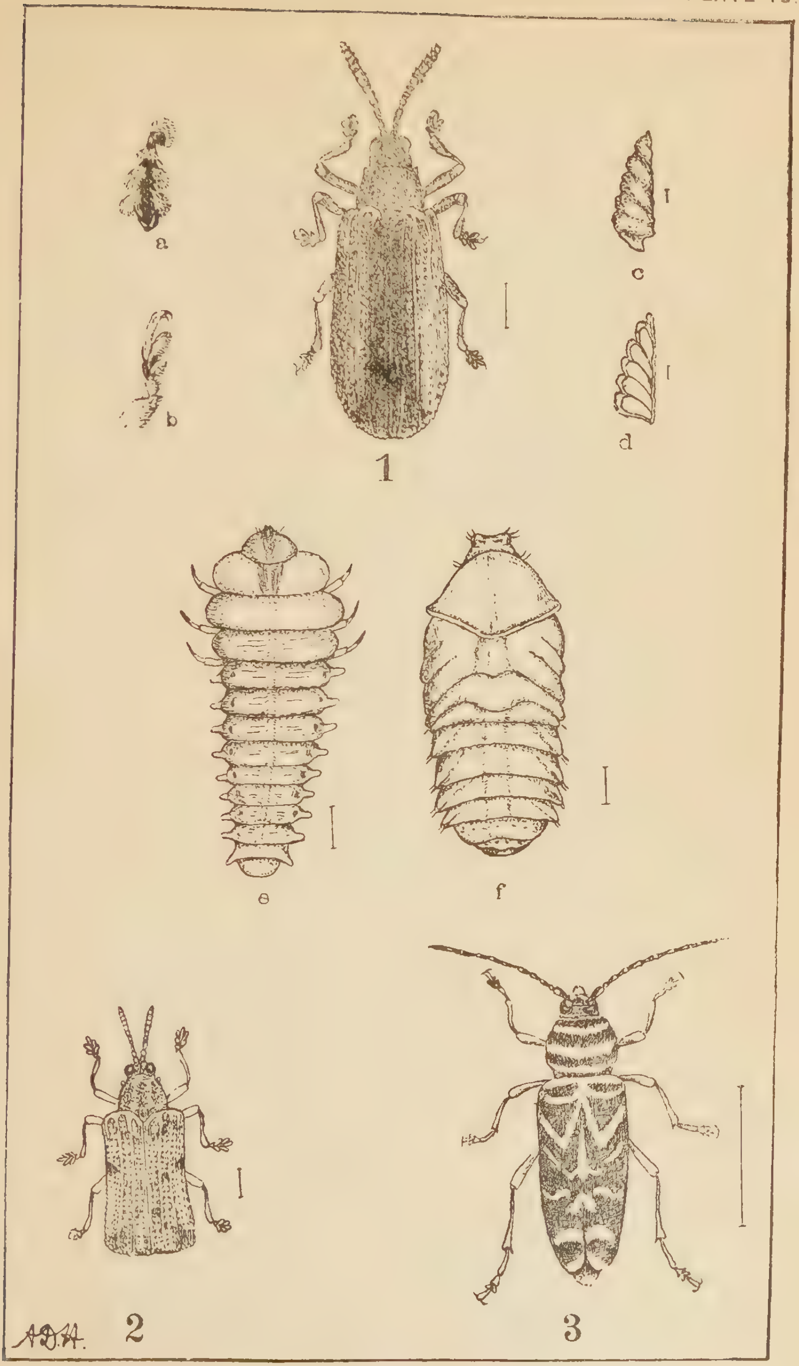
d. Longitudinal section of "c."

e. Larva of Fig. 1.

f. Pupa of Fig. 1.

Fig. 2. Odontota nervosa.

Fig. 3. Locust Borer, Clytus robinae.



LOCUST TREE INSECTS.

(ORIGINAL.)

THE LOCUST HISPA.

(*Odontota dorsalis, Oliver.*)

This beetle was extremely plentiful on the locust leaves at the time the investigation was being made, as many as eight were frequently found on a single leaf. The beetle is about one-fourth of an inch long, yellowish above with a black head and black stripe along the back. They are rough and ridgy above; but smooth and shining black beneath. They probably appear in May or June when they deposit their eggs on the under side of the leaf, which hatch into small grubs that burrow into the leaves and feed upon the substance beneath the surface; forming blisters near the edges which usually extend to the mid-rib. When these grubs or *larvae* become full grown, they resemble *e* Fig. 1, as seen in the microscope. They then change within the blister to the pupa form which the beetles soon emerge, and feed on the surface of the remaining unaffected leaves, The blisters formed by the larvæ of this insect, the leaves skeletonized by the beetle, together with the blisters formed by other leaf mining larvæ, cause the leaves to turn brown, wither and fall.

By referring to my notes and collections, I find that this beetle and another belonging to the same genus represented at Fig. 2, were taken feeding on the leaves of the locust, at Morgantown, June 10th and at Kanawha Station, June 16th.

While this insect has been known to Entomologists for a number of years, and has been frequently reported as doing damage to locust trees in different parts of the country, especially in the Middle States; very little has been written on the subject, at least as far as is at present accessible to me. It is my intention to make a complete study of the habits of this insect the coming summer, and endeavor to find, if possible, a remedy in its parasites and natural enemies.

Like the plum curculio, it is the habit of this beetle to fall to the ground when alarmed, and in the case of valued shade trees, it may be possible to destroy them by the jarring process which is so successful with the curculio. Their habit of feeding on the upper surface of the leaves would make it easy to treat them by spraying the trees with poison liquid. While it may be possible to successfully destroy these insects by jarring and spraying sufficient to preserve the foliage of a few valued shade trees, such a remedy could not be applied to those of the forest and field. This insect alone will probably do no more harm than to mar the beauty of the locust as a shade and forest tree, yet combined with other and more destructive insects found preying upon the trees, may result in a complete destruction of the locust timber, which if so, would cause a loss of not only thousands but millions of dollars to the State. It is therefore of the greatest importance that a thorough investigation should be made of the locust tree insects to find if possible a practical, natural or artificial remedy against their ravages.

(*Odontota nervosa, Panzer, Fig. 2.*)

Found quite plentiful with the locust hispa feeding upon the surface of the leaf. Nothing further has so far been observed of its habits.

THE LOCUST BORER.

(*Clytus Robinae, Forster, Fig. 3.*)

This beautiful "black velvet and gold beetle" is found feeding on the blossoms of golden rod in September. It deposits its eggs on the branches and trunk of locust trees. The eggs hatch into grubs which bore into the green wood where they feed, and if plentiful often cause the death of the tree. Many trees have been observed in and around Morgantown partly and completely dead, caused evidently by this insect. The grubs were observed early in the season within the green wood and the beetles were found quite frequent on the golden rod in September; but this insect is probably not doing much damage to the locust at present in the region infested by the Hispa.

This beetle according to Harris, Packard and Riley is "by far the most destructive pest of the locust." It "has nearly exterminated the locust in New England" and "nearly all the locust groves in the west have been destroyed by it."

Should this insect, therefore, appear in any great numbers in districts like the one mentioned, where the vitality of the trees would naturally be weakened from the loss of leaves, the locust would certainly be doomed to destruction.

Shade trees could probably be protected from the ravages of this insect by spraying the trunk and branches with a strong solution of soft soap and water during the period in which the beetles deposit their eggs, which is supposed to be between the last week in August and the first week in October. Two or three applications during this time would very likely prove successful. This, like the remedy for the Hispa would, however, only be practicable to apply to a few choice shade trees. For a general remedy, we must look as before to the natural enemies of the insect.

THE LOCUST-TREE CARPENTER-MOTH.

(*Xyleutes Robinae, Harris.*)

This is a large night flying moth. It deposits its eggs in July on the bark of mature but healthy trees. The worms, according to Dr. Asa Fitch, on hatching from the egg sink themselves inward and feed at first on the soft inner part, until when their jaws acquire more strength, they penetrate to the hard sap wood and finally resort to the solid heart-wood, residing mostly in and around the

center of the trunk, boring the wood here usually in a longitudinal direction, and moving backwards and forward in their burrows, enlarging them by gnawing their walls as they inerease in size, whereby the excavation comes to present the same diameter through its wole length. He further says that of all the wood-boring insects in our land, this is by far the most pernicious, wounding the trees the most cruelly. It perforates a hole the size of an half-inch auger, or large enough to admit the little finger, and requires three or four years for the bark to close together over it. This hole running inward to the heart of the tree and admitting the water thereto from every shower that passes, causes the decay in the wood to commence, and the tree never regains its previous soundness.

These worms probably live within the burrows in the tree three years before changing to moths. When full grown, they measure from two and one-half to three inches long. They "always attack the living and healthy trees," usually at a point where the large branches are given off. These worms we found quite frequent at Kanawha Station in April in locusts cut for posts and in oak trees cut for wood and lumber, and the large trees recently cut on the University grounds here show evidence of their destructive work. This insect also attacks the Red, White and Black Oaks, and is probably the most injurious forest tree insect known.

To prevent the moths from depositing their eggs, the same remedy as recommended for the locust borer (Clytus Robinae) applied in July or August would probably prove efficient.

THE LOCUST SPROUT AND TWIG BORER.

This is a little red caterpillar, which bores into the pith of young sprouts and tender branches. A swelling or gall is formed around the point of attack, and the sprout or branch usually dies, or breaks off at this point. This lava was found to be very plentiful and destructive in the vicinity of Morgantown, four or five being frequently found in a single sprout or branch.

Very little has so far been learned of the history of this insect; it must, however, leave its burrow and enter the ground to change to the pupa, as I have not been able to find a pupa within the burrow. Between August 7th and 14th and September 12th, to October 8th, they were found in the sprouts all sizes, from the very smallest or just hatched up to the mature worms. It is, therefore, possible that there are several broods and that they may become very destructive to young trees if neglected.

To prevent this insect from increasing, the young sprouts affected (which may readily be found by their swelled and knotty appearance), should be cut out and burned while the worms are yet in their burrows.

THE YELLOW LOCUST MIDGE.

(*Cecidomyia Robiniae, Haldeman*).

This is a minute midge or gnat. It deposits its eggs near the

margin of the leaf, which hatch into very small maggots. Their irritaton causes the edge of the leaf to thicken and roll up forming a kind of gall where the sap probably collects and furnishes them with food. This insect was found quite as plentiful as the Hispa, nearly every leaf having one or more of these galls on their edges containing both larvæ and pupæ.

This insect is possibly quite as injurious to the locust trees as the Hispa, especially in marring the beauty of the foliage, as they attack the young and tender leaves and prevent their development. For this insect there seems to be no remedy.

LOCUST LEAF MINERS.

Six undetermined species of *larvae* were observed mining under the skin of the leaves forming blisters similar to those formed by the Hispa; different species having a preference for certain and different points on the leaf. One species, a small green larvæ, is very abundant at the present time (October 8th). Nearly every remaining leaf being inhabited by one or more of them in blisters formed on the upper surface over the mid rib. On September 12th, I observed that this species was very plentiful in Wood county, the trees turning brown as they were here in Morgantown in August. The damage to the tree from this species, however, cannot be very great from the fact that they attack the leaves about the natural time for them to fall.

THE LOCUST SKIPPER BUTTERFLY.

(*Eudamus Tityrus, Fab.*)

This is a medium size butterfly of rapid flight with a large white or silver spot on the under wing, common in yards and along roadsides during the summer. They deposit their eggs singly on the leaves of the yellow locust, and the cultivated flowering variety, the eggs hatching in a few days into worms, which when young, roll up the edge of the leaves, and as they grow larger fasten two or three leaves together forming a kind of tent in which they remain through the day, coming forth to feed during the night. These worms were found very plentiful on the locust trees here, and the butterfly was found very common wherever the locust grew on our route through the State. Harris says that this worm sometimes strips the leaves from the common yellow and vicid locust trees. Spraying with poison liquids would probably preserve our shade trees from the structive attack of this insect.

LOCUST LEAF ROLLERS AND PASTERS.

Seven undetermined species were found rolling and pasting the leaves together and feeding on the inner surface of their covering; one or two species being very plentiful.

By reference to the collection and notes, it is found that seventy-eight species of insects were observed and taken on the locust trees during the season, those mentioned above being the principal ones doing damage. Of this number, forty-five species were found feeding on some part of the trees. It is my intention to continue the investigation of these locust tree insects during the coming summer and until a more complete report can be made. The results of which will appear in a future special bulletin. In the meantime, if those receiving this report who are interested in the investigation, will report their observations as to the amount of locust timber and its value in their respective localities or counties, the extent of the damage from injurious insects and such other observations of interest which may from time to time be made, it will aid very materially in making the future bulletin of special value to every one interested in the preservation of this, one of the most valuable timbers in the State.

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OF THE

WEST VIRGINIA Agricultural Experiment Station,

MORGANTOWN, W. VA.

PRELIMINARY REPORT.

BLACK SPRUCE.

—BY—

A. D. HOPKINS,

ENTOMOLOGIST.

JOHN A. MYERS, Ph. D.

Director.

MAY, 1891.

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FOREST AND SHADE TREE INSECTS.-II.

Black Spruce (*Picea Mariana*).

Preliminary Report.

As stated upon another page while passing through Randolph county on our journey of observation and collection, in July, we first learned of the destruction of the spruce timber in that section of the State; the cause of which no one seemed to know; evidently some disease or insect attack was threatening the spruce forests with total destruction. On returning to the Station and reporting the fact, a special trip was ordered. Accordingly on August 25th to August 28th, inclusive, a journey was made in company with the Botanist of the Station by rail and stage, into the Spruce forests of Cheat Mountains at a point called Winchester, on Shafer's Fork of Cheat River in Randolph county, for the purpose of making a special investigation of the unhealthy and dying condition of the Black Spruce timber in that region.

A portion of this forest was passed through on the West Virginia Central R. R. in Tucker county on the 25th, where great numbers of dead spruce trees were noted, and where extensive saw mills were at work converting millions of feet into lumber. We arrived at Elkins, the terminus of this railroad, late at night on the 25th. On the afternoon of the next day we proceeded to Huttonsville by stage, where we remained on account of rain and floods until the morning of the 28th.

Proceeding again by stage on the Staunton pike, we entered the forests in which the investigations were to be conducted eleven miles from Huttonsville at an altitude of 3,425 feet. The timber here along the road had been cut and converted into lumber; this cutting, however, only extended a short distance after which we entered the forest in its natural state. Passing through this some three or four miles it was noted that over half the timber along the road was dead and in all stages of decay. At one place along this road our driver pointed out the site of the first saw mill in this region; it having been brought there by the soldiers during the late war for the purpose of sawing lumber for their winter camp; beyond this, we came to the battle field of Cheat mountain, a clear and open

spot on top of the mountain. Here an extended view was had of the Cheat mountains extending on all sides with the blue Alleghanies beyond. Thousands upon thousands of acres of what must have once been a magnificient black-green forest of living spruce, was now viewed as an immense waste of dead and decaying trees, presenting a desolate and dreary landscape. Viewing this, we began to realize the destruction of this valuable timber, and how powerless man would be in an effort to apply a remedy for such a wide spread attack. From this point, the descent of the mountain was commenced, and Winchester or Cheat bridge—our destination—was soon reached; a postoffice, a store and a logger's camp is located here, where 45 to 50 men and 10 teams are employed by a Michigan firm to cut spruce logs, of which about ten million feet are run out each year. Seventy-five thousand acres of this spruce is here owned by this firm, fifty thousand acres of it being leased to the Sportmen Association of Cheat Mountains. The famous club house of this Association is located a mile and a half above the bridge. These are the only habitations along the river for a distance of 50 miles. The altitude at the river is 3.310 feet. Arriving here in the evening, nothing was attempted in the way of investigation until the next morning other than to make some inquiry as to the general supposition regarding the cause of the death of the timber. Among the many opinions expressed, one was that the trees had lived their natural life and were dying from old age: another that it was some disease; but the most general opinion was that it was caused by the drought of 1883(?) Some one had told them that insects were the cause but they did not credit the statement. The next morning a hatchet was procured and the investigation commenced on the first dead tree found, a vigorous application of the hatchet revealed at the first stroke evidence of serious insect attack, which upon further search was found to be the work of Scolytidae bark and timber beetles; species of which were known to have destroyed extensive forests in Germany, France, Canada and New England, hence possibly the cause of the great destruction that had been going on this region. Convincing proof, however, must be found in a tree that was dying from such an attack, none being seen, a careful search was then commenced. In tramping through the forest, over rock and logs, and tangled laurel thickets, we were forcibly impressed by the fascinating scene that surrounded us. The timber is almost entirely spruce and in all stages of growth. The soil (?) is one continued pile of boulders and rocks covered by a dense growth of club and other large growing mosses which concealed treacherous holes in which we would sometimes sink to our knees or waists, making walking, away from the regular roads and paths, both difficult and dangerous. On this damp moss-covered rocky surface, the spruce grows, their roots extending down through the crevices where they find abundant moisture in the ever running water of thousands of mountain springs. Years ago this forest was called by travelers the "Shades of Death," suggested perhaps by the dense black foliage of the spruce and the thick undergrowth of laurel, where old, pros-

trate and decaying trees were seen frequently three and four deep covered by a thick damp mantle of moss, in which other vegetation attempting to grow would soon fade and die. As we view the destruction that had been going on here among the trees within the last few years, we see that in reality a shadow of death had passed over this region, the cause of which it was now our duty if possible to determine. Although the dead trees on every side bore abundant evidence that the timber had been killed by insects, no trees could be found actually dying from such effect, until we reached the top of a mountain where the loggers were at work, here the object of our search was found, being a small tree about eight inches in diameter not yet entirely dead. Procuring an ax the tree was felled and abundant and convincing proof of the cause of its death was found when a portion of the bark was removed revealing hundreds of little insects which had mined through the bark in all directions checking the flow of sap thus causing the death of the tree. Beetles were also found in the green bark and sap wood. The men who were watching the operation with evident curiosity and interest admitted that they were convinced and expressed wonder that they had never discovered the fact. Sections of this tree were cut, which were kindly carried to the camp by the men who offered any further services we might desire. Mr. Steel, the foreman of the camp, being especially kind in giving us assistance and information. Farther search was made for dying trees and a number of others were found, where swarms of small gnats were observed flying around the trees and alighting on the bark. Supposing these to be parasites careful search was made in the bark, where the same insects were found in the mines of the bark borers on which they had evidently been feeding. Several other species of insects were also found feeding on these bark borers. We had thus found the possible and evident cause of the timber dying, and the probable natural remedy which had checked this cause and prevented further destruction. Much, however, remains to be studied out before convincing proof can be had as to which species should be changed with their death, and which should have the credit for the better condition of the forest. These trees were again visited on September 1st, the bark carefully examined, and sections of the trees cut and sent to the Station for further study. On returning to the Station, these sections were placed in large cylindrical glass jars, the mouths of which were covered with coarse muslin secured by rubber bands. I have thus been able to note the insects which have since emerged from the sections. I am now in correspondence with timber men in different sections of the forest with a view of securing additional information; and with Profs. Riley and Howard of the U. S. Division of Entomology, to whom I sent examples of the insects taken in the forest, and from the breeding jars, for determination. They have kindly determined such of them as were known; several of them proving to be new species. A list of the insects taken, with cuts and descriptions of the principal injurious and beneficial ones, will appear

later in a special bulletin on this investigation. I will probably visit the forests from time to time until the investigation is completed.

It is hoped and believed that with a further knowledge of the parasites of the spruce Scolytidæ and their habits, that they may be successfully introduced into forests where the trees are just commencing to die and thus prevent a wholesale destruction of the timber.

EXTENT AND DISTRIBUTION OF THE SPRUCE FORESTS OF WEST VIRGINIA.

Valuable information in regard to the extent of the forests was obtained from Col. E. Hutton, who is an extensive land owner and dealer and is thoroughly acquainted with the land and timber of the mountain regions in this section of the State. According to his estimate, the spruce forests are distributed as follows:

Randolph county,	15,000 acres on Elk and Gauley waters.
	120,000 acres on Cheat River waters.
	5,000 acres on Mill creek.
	500 acres on Elk mountain.
Pocahontas county,	20,000 acres on Shafers' Fork of Cheat.
	100,000 acres on the head of Greenbrier.
	100,000 acres on Gauley and Elk head waters.
Tucker county,	50,000 acres on Cheat waters.
Mineral county,	25,000 acres.
Greenbrier county,	33,499 acres by actual survey, on Cherry Tree

river, making a total of nearly 500,000 acres, or about 800 square miles of spruce forest. He thinks the actual amount will go over rather than under this estimate. His estimate that there were 25,000 acres in Greenbrier county, was proved by actual survey to exceed that amount over 8,coo acres.

INFORMATION CONCERNING TIME WHEN TIMBER COMMENCED AND CEASED DYING IN CHEAT REGION.

Col Hutton stated that he observed trees commencing to die in the Cheat region about ten years ago, or between 1880 and 1882, the destruction continued for five or six years, the trouble spreading until over 300,000 acres was more or less affected. He farther stated that the timber did not die over all the forest alike; but in patches of from 60 to 1,000 acres, and that the largest and best trees seemed to be more frequently affected than the smaller trees. Mr. Hanbric, who is the game-keeper of the Sportsmen's Association, says that he has spent almost all his life in these forests as a hunter, and that he has been observing the spruce timber for the last ten years. He says that in the summer of 1882 there was a very severe drought here, that in October following the timber commenced to die, continuing through the winter and much worse the following summer, the trees then died scatteringly until 1885. No trees to his knowledge have died here within the last three years;

but he observed last fall that they had commenced to die in Pocahontas county where the timber had been heretofore unaffected.

INFORMATION CONCERNING CAUSE OF DEATH OF TREES.

The general supposition by people living here is that the timber died from the effect of the drought of 1882, some claimed that the trees had come to maturity and were dying from old age, giving giving their reasons that the larger trees seemed to die worse than smaller ones, while a very few thought that it might have been caused by insects. Col. Hutton has obrerved that at certain times in the year, while the timber was dying the air would be full of little "bugs:" that from the numbers would get in one's hair and be otherwise annoying. He had cut into green logs and trees and found "bugs" in the sap wood, thus concluding that they had something to do with the death of the trees. He supposed, however, that the other insects found in the bark only attacked the trees after they were dead.

Captain Parsons, a railroad surveyor who has conducted surveys through this forest at different times, stated that he had often observed that in a few years after they made such a survey the timber commenced to die on either side of the path made by the hacking and cutting necessary in their progress through a forest of this kind, and that if small bushes or trees were cut and lodged against living ones would often cause them to die.

Mr. S. L. Riger, of Phillippi, who has observed the spruce forests before and after the trees commenced to die, stated that his theory as to the first cause of the trouble was, that the deer hunters made burnings in the forests from which the green trees would commence to die on all sides and the trouble would continue to spreed until checked by some unknown cause. He said that it was supposed by some that the trees had lived their natural life. Others supposing that their death was from drought, others that it was caused by a "bug," and still others who were confident that the trouble was caused by a fly which they had observed flying around the trees. He further stated that the trees seemed to die worse in the fall and winter than at other times.

ANSWERS TO CIRCULAR LETTERS.

In answer to the following questions mailed to lumber and timber companies operating in the spruce as to when the timber commenced to die in their respective localities.

No. 1, Huling Lumber Company, Tucker County: answers within ten or fifteen years.

*No. 2, Black Water Lumber Company, Tucker County, about 1887.

*No. 3, Silas Sharp, Pocahontas County: In the year 1887.

*These localities are widely separate from that in which the investigations here reported were made; no general drought has been reported since 1882.

No. 4, St. Lawrence Company, Greenbrier County, 1883.

As to the cause of their death:

No. 1, answers: Don't know; worms.

No. 2, answers: Everybody gives it up.

No. 3, answers: The general opinion is on account of drought. The "Pine" generally grows in rocky places, and there was not dampness enough to keep the trees alive.

No. 4, answers: Two very dry summers in succession.

Are the trees dying at the present time:

No. 1, answers: Yes, to some extent.

No. 2, answers: It is said not. Said death is checked.

No. 3, answers: Not more than common.

No. 4, answers: No.

How long does the timber continue to die in one locality?

No. 1, answers: About three or four years:

No. 2, answers: Generally one season.

No. 3, answers: Two years:

No. 4, answers: About three years.

What proportion of the timber in your locality is now dead?

No. 1, answers: One-fourth.

No. 2, answers: Twenty-five per cent.

No. 3, answers: The highest points of timber.

No. 4, answers: 15 per cent.

What is the present value of standing dead trees for lumber, and what is the probable time in which they may yet be profitably worked.

No. 1, answers: About equal value for three years: After that time it very rapidly deteriorates.

No. 2, answers: It depends on time of cutting after date.

No. 3, answers: The dead timber is as good for lumber as if it was green. It will be good for a year yet.

No. 4, answers: About two-thirds of the value of green timber. Will be good yet for four or five years.

Mr. Hugh Maxwell, of Tucker County, an observing and intelligent gentleman, answers as follows:

"I can state two or three facts:

1st. The spruce timber in the affected districts is nearly all dead. There are certain strips, however, unaffected.

2nd. They use the dead timber for pulp from which to make paper. This is now an extensive industry here.

3rd. It is the prevailing opinion here that the death of the trees is due to parasites.

4th. It seems that wild cherry is replacing the dying spruce."

PERSONAL OBSERVATIONS.

Trips were made in all directions from Cheat Bridge. Dead trees were examined in all stages of decay. Stumps and tops examined in cuttings of 1884, 1887, 1888, 1889 and 1890. Their condition as to insect attacks and decay and the time of year in which the tim-

ber was cut was carefully noted. Every species of insect which seemed to be in any way connected with the spruce as taken, and notes made on their habits as far as observed, (which will be reported later).

Past history of the ravages of these insects in the spruce forests of this and other countries and the information that I have obtained from personal observation and inquiry, indicate that such wholesale destruction of timber always follows some great injury to the forest by storms, fires or drought. This we may account for in the following manner: The species of scolytid bark and timber beetles, which are supposed to be the main cause of the trouble, no doubt have a preference for injured trees or recent prostrated limbs, in which they are always more or less plentiful, and in such they may continue to breed for many generations, increasing or decreasing according to the supply naturally furnished by an occasional uprooted tree or broken limb, never being allowed in the natural order of events to increase sufficiently to attack and and kill the healthy trees. When, however, something unusual occurs to injure any large amount of timber, nature is then thrown of her balance, and no longer preserves natural order, and an equal division her species. The insects which have so long been prevented from increasing to their full extent by the meagre supply of natural food, lack of favorable conditions, and occasional attack of their enemies, now furnished with abundant breeding ground, and favorable conditions in the injured forest, increase with astonishing rapidity.* By the third year, they will have increased to countless numbers, taking the character of an invasion, attacking trees and continuing on their march of destruction like a victorious army through an enemies country until checked by reinforcements in the ranks of their natural enemies.

It is therefore possibly a fact, as is generally supposed, that the extreme drought of 1882 and 1883 had something to do with the wholesale death of the trees which occurred in certain localities in the Cheat mountain forests between 1882 and 1886. The timber on the extreme rocky points no doubt was thus very materially injured, many of the trees dying from the effects of the drought alone, thus forming a nucleus from which an invasion of the beetles might extend to and destroy living trees. This was evidently the case in the locality mentioned. Points were found here so rocky that it seemed almost impossible for the roots of the trees to find either soil or moisture. Trees that once flourished on these points were now dead, and in an advanced stage of decay. Were these dry points the only places where trees were found to be dead, we might safely infer that the drought was the cause of their death; such we found was probably not the case, as the characteristic dead trees were observed on river bottoms, deep and fertile soil and even in swampy places in the infested districts.

These affected portions of the forest from 50 to 1,000 acres in ex-

*It is estimated that these scolytids will increase from one female at the rate of 1,80 the first year, 8,010 the second year, and 729 million the third year.

tent, are located indiscriminately through the forests separated by tracts of green timber of greater or less extent. Old White Top Mountain near Cheat Bridge seems to have been the nucleus of the trouble in that region. The clearing made by a pioneer settler on this mountain, the opening of the Parkersburg and Staunton turnpike through the forest here, the old saw mill and the camps of General Reynolds' soldiers located here in the winter of 1861, the injuries by the three engagements of September and December, 1861, followed by forest fires, storms and drought in later years, furnished a succession of favorable conditions for the increase of the injurious scolytids, so that when the drought of 1882 impaired the health of other portions of the forest on this mountain, hosts of these beetle were ready to attack the injured trees from which they seem to have spread to those that were healthy and green, thus resulting in the wholesale death of thousand's of dollars worth of valuable timber.

PROBABLE EXTENT OF THE DAMAGE.

Colonel Hutton stated that about a 75 per cent. of 170,000 acres on Cheat waters and 10 per cent. of 140,000 acres on Gauley and Elk waters were dead. S. L. Riger, of Phillippi, stated that two-thirds of the 100,000 acres on Cheat waters was dead. From my own observations, I should judge that forty per cent. of the trees were dead of the 15,000 to 20,000 acres near Cheat Bridge. Col. Huttons' estimates are probably as near correct as it is possible to get them, from these we judge that at least 1,500,000 dollars worth of timber is now dead in the spruce forests of West Virginia.

PRESENT VALUE OF DEAD TREES FOR LUMBER AND TIME THEY MAY BE PROFITABLY WORKED.

Statement of Mr. George Steel, of Winchester, W. Va., foreman of an extensive logger's camp:

"I have been here three years. We keep on an average 45 men and 10 teams. We cut and run into the river about ten million feet of logs each year. We have been cutting these dead trees right along, and I can not see much difference as to decay. The dead trees that we are cutting now will make very good lumber, and it is my belief that they will be good for lumber for at least three years. No large trees have died in this locality to my knowledge since I have been here."

On visiting the extensive saw-mill belonging to the same company located at the mouth of Cheat river, the following statements were obtai ed from Mr. Kysor, superintendent of the mill:

"The first logs we sawed here was in August, 1889, about 200,000 feet of which was felled in 1884 and 1885, only about 5 per cent being discarded or thrown into the slab pile. The logs from trees of this cutting that were dead when felled made third-class lumber. The logs sawed last spring were from trees cut all the way from first

to third-class lumber; a much less per cent being discarded in this last sawing than in the first. There is now in the yard out of three million feet sawed: 2,000,000 feet of first-class lumber and above, 700,000 feet of second-class lumber (piece stuff and weather-boarding) and 100,000 feet of third-class lumber. This lumber sells here at an average of about $12 per thousand. The third-class sells for $8 per thousand, and we sell more of it in proportion than we do of firsts and seconds.

PERSONAL OBSERVATIONS.

From a careful examination of the trees in the healthy and affected districts and of the stumps and tops in cuttings of 1861 and 1884–1890, a tolerably correct idea of the durability of the timber was formed, from which, I should judge that where these affected tracts are accessible to a railroad or stream large enough to float out logs, that this timber may be profitably worked within eight years after it dies.* It is therefore possible that much of this timber might be saved. From the fact that large companies are now operating in it, and that thousands of acres of these affected portions of the forests, together with healthy portions, may be bought very cheap, and within the next three or four years no doubt much of this timber could be worked at a profit to operators, and a great saving gained thereby. We would therefore suggest that the districts already dead should be felled and converted into lumber as soon as possible.

When it is considered that the scarcity of spruce and other timber of the world is becoming an alarming matter, the saving of a portion of the immense amount of timber which is now dead should certainly receive the universal attention of foresters and others who are interested in the preservation of the great forests of West Virginia, for practically every dead tree converted into lumber or pulp 'ere it decays saves its value.

Summary.

The spruce forests of West Virginia are estimated to exceed 500,000 acres.

Isolated portions in these forests are dead, possibly to the amount of 150,000 acres.

While conducting an investigation in one of these affected portions, all of the characteristic dead trees there bore abundant evidence of the attack of insects belonging to the family Scolytidæ.

A number of small trees were found partly dead, and dying near where trees had been cut last summer.

Great numbers of bark and timber beetles were found in the bark and sap wood of these dying trees both in the green and dead portions.†

*This statement applies only to this Cheat Bridge region. In other portions of the forests, especially in Tucker county, the timber rots quite soon after death.

†Principally Polygraphes rufipennis, Kby.; and Xloterus bivittatus, Kirbey.

Three species of parasites* of these beetles were plentiful, and were noted flying around and on the bark of the infested trees. Some of them were observed with their ovipositors inserted into the bark, while others were entering and emerging from the burrows made by the beetles. Here evidence was obtained of the possibility of these beetles being destroyed or reduced by natural means to such an extent that they could no longer be destructive to trees.

These same beetles were found very plentiful in the logs, stumps and tops of last summers cuttings, near these dying trees.

There was very little evidence of the attack of these beetles on the stumps and tops of the 1887 cuttings, indicating that at or near the time that the timber ceased dying in this locality these insects were not plentiful.

Conclusions.

The conclusion arrived at from personal observation and notes leads me to believe that the death of the trees is probably due to the combined effect of two causes.

1st. The ravages of the insects primarily succeeded some injury to probably a few trees in isolated localities.

2nd. When the conditions were no longer favorable to their existence in the injured trees, and they had increased to great numbers, the possibility of their attacking the healthy trees from sheer necessity and continuing to spread until checked by some natural cause, seems to me evident. I reach this conclusion from the fact that I have found these same scolytids working in the green, sappy wood and bark.

Still further investigations will be made in the spruce forests of the State in this and other localities, and a final report will appear in a future bulletin. This bulletin will also contain a list of all insects taken in these forests, and such other additional facts as may be determined.

*Species—Trigonoderus, Helorus, and Spintherus, n. sp.

Bulletin No. 18.

WEST VIRGINIA

Agricultural Experiment Station;

MORGANTOWN, W. VA.

LAW AND REGULATIONS CONCERNING THE SALE OF COMMERCIAL FERTILIZERS IN THE STATE OF WEST VIRGINIA. ANALYSES.

CONCLUSION.

27 PER CENT. OF THE COMMERCIAL FERTILIZERS SOLD IN WEST VA. FALL BELOW THE MANUFACTURERS GUARANTEE.

SEPTEMBER, 1891.

CHARLESTON:
MOSES W. DONNALLY, PUBLIC PRINTER.
1891.

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D. D. JOHNSON, A. M., ... Agriculturist.
RUDOLF J. J. DE ROODE, PH. D., ... Chemist.
SUSIE V. MAYERS, . . . Stenographer and Book-keeper.

Inspection of Commercial Fertilizers.

The law regulating the inspection and sale of fertilizers in West Virginia does not appear to be understood by manufacturers and others. There are so many misapprehensions upon the subject that I deem it advisable to print the law in full together with our arrangements for conducting the analytical work and inspection.*

AN ACT concerning Commercial Fertilizers, and repealing chapter twenty-five of the Acts of the Legislature of West Virginia of 1879. (Chap. LXXII.)

[Passed March 6, 1891.]

Be it enacted by the Legislature of West Virginia:

1. Every person or company who shall sell, offer or expose for sale, in this State, any commercial fertilizer or manure, shall affix conspicuously to every package thereof a plainly printed statement, clearly and and truly certifying the number of net pounds of fertilizer in the package, name, brand or trade mark under which the fertilizer is sold, the name and address of the manufacturer, the place of manufacture, and a chemical analysis, stating the percentage of nitrogen or its equivalant in amonia, of potash soluble in distilled water, and of phosphoric acid in available form, soluble in distilled water, and reverted, as well as the total phosphoric acid. In the case of those fertilizers which consist of other cheaper materials, said labels shall give a correct general statement of the composition and ingredients of the elements relied upon, contained in the fertilizer which it accompanies. If any such fertilizer be sold in bulk, such printed statement shall accompany and go with every lot and parcel sold, offered or exposed for sale.

2. Before any commercial fertilizer is sold, offered or exposed for sale in this State, the manufacturer, importer or party who causes it to be sold, exposed or offered for sale, shall file with the Director of the West Virginia Agricultural Experiment Station a certified copy of the statement named in section one of this Act, and shall also

* The Director is responsible for this bulletin. The analytical work was done by Dr. De Roode, B. H. Hite and the Director working together.

deposit with said Director, a sealed glass jar or bottle, or sealed tin can, containing not less than one pound of fertilizer named and described in said statement, accompanied by an affidavit that it is a fair average sample thereof. The making of any affidavit required by this chapter falsely, shall be perjury.

3. The manufacturer, importer, agent or seller of any brand of commercial fertilizer or material used for manurial purposes, shall pay for each brand at the time he files the statement required in section one of this Act, an analysis fee of ten dollars for each of the fertilizing ingredients claimed to exist in each and every brand as fertilizer which he sells, offers or exposes for sale within this State, provided that whenever the manufacturer or importer shall have paid the analysis fee herein required, for any particular brand of fertilizer, no agent or seller shall be required to pay any other or further analysis fee for said brand.

4. The analysis fee required to be paid by section three of this act shall be paid to the Treasurer of the West Virginia University for the use of the Agricultural Experiment Station, and the party making such payment shall take from said Treasurer triplicate receipts therefor, one of which he shall retain, and the other shall be deposited, one with the Director of the Agricultural Experiment Station, and the other with the Secretary of the Board of Regents of the West Virginia University, and by them filed and preserved in their respective offices.

5. Immediately after the filing of the receipt aforesaid with the Director of the Agricultural Experiment Station, said Director shall issue a certificate to the party making such payment, stating the amount of fees paid, and the name, brand or trade-mark under which the fertilizer is sold, the name and address of the manufacturer or importer, the place of manufacture, the name and place of business of the dealer, and the chemical analysis as set forth in the statement by section one of this act, and that the applicant for said certificate is authorized to sell said fertilizer within the State of West Virginia for the period of one year from the first day of January to the 31st day of December, inclusive. Said certificate may be issued at any time for and during the current year, and may be issued during the month of December for the year commencing on the first day of January thereafter.

6. It shall be the duty of the Director of the West Virginia Agricultural Experiment Station to make or cause to be made a chemical analysis of every sample of commercial fertilizer so furnished him, and he shall print the result of such analysis in the form of a label or tag. Such printed label or tag shall set forth the name of the manufacturer, the place of manufacture, the brand of the fertilizer, and the essential ingredients contained in said fertilizer, expressed in terms and manner approved by the Director, together with a certificate from the Director, setting forth that said analysis is a true and complete analysis of the sample furnished him of such brand of fertilizer of the ingredients claimed to be contained therein. And he shall also place upon each lable or tag the money value

per ton of such fertilizer, computed from its composition, as he may determine. The Director shall furnish such labels or tags in quantities of one hundred, or multiple thereof, to any person or company complying with this act, and desiring to sell, offer or expose for sale, any commercial fertilizer in this State, and shall receive therefor the sum of fifty cents for every one hundred so delivered, and shall without delay pay the same to the Treasurer of the West Virginia University for the use of the Agricultural Experiment Station, and take duplicate receipts therefor, one of which he shall retain and the other he shall deliver to the Secretary of the Board of Regents, who shall file and preserve the same in his office.

7. The Board of Regents of the West Virginia University shall expend the money received under the provisions of this act in meeting the legitimate expenses of the Station, in making analysis of fertilizers, in experimental tests of same, and in such other experimental work and purchases as shall inure to the benefit of the farmers of this State, and shall include in their annual report a statement of the receipts and disbursements thereof.

8. The Director of said Experiment Station is hereby authorized in person or by deputy to take samples for analysis from any lot or from any commercial fertilizer which may be in the possession of any dealer in this State. And he is hereby authorized to prescribe and enforce such rules and regulations as he may deem necessary to carry fully into effect the true intent and meaning of the this act; and any agriculturalist, a purchaser of any commercial fertilizer in this State, may take a sample of the same under the rules and regulations of the Director of the said Experimental Station, or forward the same to the Experimental Station for analysis, and if the Director has reason to believe that the manuracturer of, or dealer in, said fertilizer has made any false or fraudulent representation in regard to said fertilizer, he shall cause the said sample to be analysed free of charge, and certify the same to the person forwarding the sample.

9. Said Director shall also publish, by bulletin, the brand, name and location of the manufacturer, and chemical analysis of every fertilizer analysed or caused to be analysed by him. Said last publication to be made, if practicable, before the time at which said fertilizer is to be applied to the soil.

10. Any manufacturer or vendor of any chemical fertilizer who shall sell, or offer or expose for sale, any commercial fertilizer without having previously complied with the provisions of this act hereinbefore set forth, shall be deemed guilty of a misdemeanor, and upon conviction thereof, shall be fined not less than fifty nor more than five hundred dollars.

11 Any company, firm or person who shall wilfully remove from or deface or change any label, or tag, or brand affixed to any package of fertilizer under the provisions of this act, before such fertilizer has been used for manurial purposes, or who shall sell such fertilizer without such label or tag being affixed thereto at the time of sale, shall be deemed guilty of a misdemeanor, and upon conviction

thereof, shall be fined not less than ten more than fifty dollars for each offense.

12. Any company, firm or person who shall remove from or cause to be removed from any package of commercial fertilizer any statement, label or tag affixed thereto under the provisions of this act, and affix or cause the same to be affixed to any other package of commercial fertilizer, shall be deemed guilty of a misdemeanor, and upon conviction thereof, shall be fined not less than ten nor more than fifty dollars for each offense.

13. Any company, firm or person violating any of the provisions of this act, or who fails to comply with the requirements of this act, shall be deemed guilty of a misdemeanor, and upon conviction thereof shall, when no other penalty is prescribed, be fined not less than ten nor more than one hundred dollars for each offense. But this act shall not be construed to apply to any one who manufactures fertilizers for his own use and not for sale.

14. The Director of said Experiment Station shall report to the prosecuting attorney of the county wherein the offense was committed, all violations of the provisions of this act, and failure to comply therewith, and a copy of any statement, label or tag required to be filed with said Director, or prepared by him, and any analysis made or caused to be made by him, when duly certified by said Director, shall be received in evidence in any prosecution or a suit for any violation of the provisions of this act.

15. That chapter 25 of the Acts of the Legislature of West Virginia, passed on the 4th day of March, 1879, entitled "An act to protect the purchasers of fertilizers in this State," be and the same is hereby repealed.

The following is the form of affidavit required under Sec. 2 of the law. Blank copies of the same will be furnished by the Director free of charge upon application.

Manufacturers or dealers sending samples of Commercial Fertilizers for analysis under the "Act Concerning Commercial Fertilizers" in West Virginia, will please fill out and send with the sample the following affidavit. Addressed to Dr. John A. Myers, Morgantown, W. Va.:

I, ..., of ...., do hereby certify that the sample........ of the following named Commercial Fertilizer .... sent this day by .... to Dr. John A. Myers, Morgantown, W. Va., contained in ...., correctly labeled and securely sealed, for analysis under the Act of the Legislature of West Virginia, "Concerning Commercial Fertilizers," to the best of my knowledge and belief truly and fairly represents the chemical composition of the fertilizer .... as manufactured and offered for sale by us in the State of West Virginia. The manufacturers guarantee the following minimum analysis:

Name and trade mark of fertilizer.	Manufacturers name and address.	Name and address of sender.	Minimum per cent. of nitrogen guaranteed.	Minimum per cent. of soluble phosphoric acid guaranteed.	Minimum per cent. of reverted phosphoric acid guaranteed.	Minimum per cent. of available phosphoric acid guaranteed.	Minimum per cent. of total phosphoric acid guaranteed.	Minimum per cent. of potash guaranteed.	Minimum net weight of package guaranteed.
1									
2									
3									
4									
5									
6									
7									
8									

Given under my hand and seal this .... day of ...., 189..... Signed ....

I, ..., a Notary Public within and for the county of .... State of .... do hereby certify that the above statement was sworn to before me by .... of .... on this .... day of ...., 189............

Given under my hand and official seal as Notary Public, this........ .... day of ...., 1891.

NOTARY SEAL.

.. ..

Notary Public.

The following blank is supplied to farmers, free of charge, who may wish to submit samples under section 8 of the Act:

Farmers sending samples of fertilizers for analysis under the Act of the Legislature of West Virginia, passed March 6th, 1891, will please fill out and send the following blank by mail to Dr. John A. Myers, Morgantown, W. Va.:

I hereby certify that the sample of fertilizer known and sold as

....
(Name of Brand.)

was bought by me of..
(Dealer's Name and Address.)

West Virginia, ..., and that it rep-
(Date of Purchase.)
resents fairly the quality of the fertilizer as delivered to me. The fertilizer is guaranteed by the manufacturer to have the following chemical composition:

....
(Copy the Analysis.)

....

....

....

....

It is sold at $...... per ton cash or $...... per ton upon time. The Director's tag taken from one of the packages is enclosed with the sample.

Sign, ...
Date, ..., 189..
Address, ...

I hereby certify that I witnessed the taking of the above named sample by.................................., and that I believe it represents fairly the quality of fertilizer bought by him, and sampled for analysis. I further state that I have no financial interest in the above transaction.

Sign, ...
(Name of some other Person.)
Date, ..., 189.., Address,..................

NOTICE.—Farmers and others in taking samples for Analysis will please follow closely the directions given for sampling fertilizers.

JOHN A. MYERS, *Director.*

Directions for Taking Samples of Fertilizers for Analysis.

1st. All analytical work is based upon the supposition that the chemist receives a fair sample for analysis and all persons should exercise special care in securing an average, fair sample, which may best be accomplished—

(*A*) *If from bulk*—.

By taking a shovel or scoop full from a number of places in the pile and rapidly and thoroughly mixing these quantities together, then taking the sample from this mixed mass. The mixing may be done upon a clean floor with the shovel or scoop by repeatedly shoveling the heaps together after separating it into several parts. The whole operation should be continuous and rapid so that there will be no appreciable change of moisture. The mixing should be sufficient to cause soft or moist masses to be broken up and thorougly inter mixed with the body of the fertilizer, but care should be observed not to pulverize hard dry lumps so as to change the physical character of the fertilizer. In other words the chemist should receive a fair sample both as to chemical and physical properties.

(*B*) *If from barrels, sacks or packages.*

By opening the sack, barrel or package and thoroughly mixing the contents down to about one-half of its depth by means of a shovel or scoop then if need be withdrawing several scoops full and thoroughly mixing upon a floor exactly as under "*A*". It is best to take scoops or shovels full from several sacks or packages and mix these as directed, then take the same for analysis from the mixed mass. Observe the conditions given under "*A*". Fair samples are best secured from fresh packages and *farmers will do well to draw all samples immediately after purchasing.*

2nd. Care should be observed to attend to the drawing of the sample without delay and sample should be promptly selected, labeled and shipped. In the case of a manufacturer or dealer this sample is accompanied by the affidavit required by law (see directions to manufacturers). If the sample be sent by a farmer, for mutual protection, *it is best, though not required*, that it be drawn and sealed in the presence of a disinterested party who should join the farmer in certifying that the sample fairly represents the goods as purchased by him In the *case of the farmer there is no charge for the analysis*, but the *express charges upon the sample should be prepaid.* Proper blanks will be provided by the Director free of charge for all farmers applying for them.

Samples received at the Experiment Station from Manufacturers will be analyzed in the order received. *Manufacturers and dealers are, therefore, urged not to wait to the last moment to send in their samples, but to send them as soon as possible.*

Instructions to Manufacturers and General Agents.

Manufacturers of Commercial Fertilizers, selling their goods in this State, will please observe the following points in complying with the Act of the Legislature of West Virginia, passed March 6th, 1891, and now in force:

1st. A compliance with the law requires that before any commercial fertilizer is sold, offered or exposed for sale in this State, the manufacturer, importer or party who causes it to be sold, exposed or offered for sale, shall file an affidavit with the Director of the West Virginia Agricultural Experiment Station, at Morgantown, W. Va., giving a correct statement of the net pounds in the packages, the name of the brand or trade-mark under which the fertilizer is sold, the name and address of the manufacturer, the place of manufacture, and the chemical analysis stating the percentage of nitrogen, or its equivalent in ammonia, the percentage of potash soluble in distilled water, and the percentage of phosphoric acid in available form, soluble in distilled water, and reverted, as well as the total phosphoric acid. In the case of those fertilizers which consist of other cheaper materials, the affidavit shall give a correct general statement of the composition and ingredients of the elements in the fertilizer relied upon to produce fertilizing effect upon the soil.

*2d. The manufacturer is required to send with the affidavit a fair sample of the fertilizer in a sealed jar, bottle or tin can for analysis. An ordinary quart fruit jar or can filled with a fair sample of the fertilizer will answer. Each can or jar should be properly sealed, labeled and packed, and shipped prepaid by express to Dr. John A. Myers, Morgantown, W. Va.

3d. The manufacturer is required to pay at the time of filing the affidavit an analysis fee of $10 for each and every fertilizing ingredient claimed by him. If he claims potash, phosphoric acid and nitrogen, it is $10 for each, or $30 for a complete fertilizer, consisting of all three of the above named elements of plant food. This fee should be sent in a draft upon New York or Baltimore, payable to "The Treasurer of the West Virginia University."

4th. The manufacturer is required to place a label or tag upon each package, giving the name of the brand, its correct net weight, analysis and commercial valuation per ton. These labels are provided only by the Director of the West Virginia Agricultural Experiment Station, are regularly numbered and can only be had by the parties filing the affidavit before mentioned. The law establishes the price at 50 cents per 100 labels or tags. Manufacturers requir-

*Manufacturers will please keep a sample of the same lot for analysis by their own chemist.

ing these tags or labels should indicate to the Director the number of each kind required, and send a check payable to John A. Myers, Director, for the amount. They will be sold in packages of 100 each, and manufacturers will please order by even hundreds.

5th. As this is the first season that this law goes into effect, the Director will expect all fertilizers now in the State, and being offered for sale, to be properly labeled or tagged ready for inspection, on or before August 15th, 1891, and all fertilizers offered for sale in this State after this date, July 7th, 1891, are subject to the provisions of the law.

Manufacturers and agents will therefore please to take immediate steps to comply with the above indicated provisions, which are intended to guide them. The Director will furnish the necessary blanks for complying with the law, free of charge, and will aid the manufacturers in any way in his power to comply with its requirements. All affidavits and applications for labels should be filed as soon as possible.

Address all communications to

DR. JOHN A. MYERS,
Morgantown, W. Va.

Valuations for 1891.

The commercial valuation of fertilizers is based upon the average retail price of the ingredients from which they are compounded. We are aware of the fact that there are sometimes sudden fluctuations in the prices due to speculation, variations in the supply and demand, etc., but we are confident that the valuation given below should fairly represent the average price at which the fertilizers may be retailed in this state. *By proper negotiations in many cases where favorable freight rates prevail, the fertilizer may be bought for less than these prices.*

TRADE VALUES OF FERTILIZING INGREDIENTS IN RAW MATERIALS AND CHEMICALS FOR 1891.

Nitrogen In Ammonia Salts,	19c.
" In Nitrates	17c.
Organic Nitrogen In dry and fine ground fish meat and blood,	19c,
In cottonseed meal and castor pumice,	15c.
In fine bone and tankage,	16½c.
In fine medium bone and tankage,	13c.
In medium bone and tankage,	10½c.
In coarse bone and tankage,	8½c.
In hair, horn shavings and coarse fish scrap,	8c.
Posphoric acid soluble in water,	8c.
Soluble in citrate of ammonia (reverted),	8c.
" In ground fish, fine bone and tankage,	7c.
In fine medium bone and tankage,	6c.
In medium bone and tankage,	5c.
In coarse bone and tankage,	4c.
In fine ground rock Phosphate,	2c.
Potash as high grade sulphate and in forms free from Muriates (or chlorides),	6c.
As Kainite,	5c.
As Muriate,	5c.

TRADE VALUE OF MIXED FERTILIZERS AND SUPERPHOSPHATES OF HIGH GRADE.

Nitrogen	19c.
Available Posphoric Acid	8c.
Insoluble Phosphoric Acid	3c.
Potash	5c.
Phosphoric Acid in fine ground bone, i. e. passes through 1-25 inch mesh sieve,	4½c.
Phosphoric Acid in medium ground bone, i. e. passes through 1-16 inch mesh seive, but not through 1-25 inch mesh sieve,	4½c.

The commercial value of a fertilizer is found by multiplying the number of pounds of each ingredient per ton as shown by analysis by the price of each, and taking the sum of these products. For example we have the following analysis:

Moisture	11.50	per	cent.
Soluble phos. Acid.	9.00	"	"
Reverted " "	2.50	"	"
Available " "	11.50	"	"
Insoluble " "	1.00	"	"
Total " "	12.50	"	"
Nitrogen	2.00	"	"
Potash	3 00	"	"

Available Phosphoric Acid	11.50x20x8–	$18.40.
Insoluble " "	1.00x20x3–	0.60.
Nitrogen	2.00x20x19–	7.60.
Potash	3.00x20x5–	3.00.
Commercial value per ton		$29.60.

This does not represent the Agricultural value of the fertilizer, which depends upon the crop, soil, weather, etc., as well as upon the character and amounts of the ingredients.

Name of Brand.	Address of Manufacturers or General Agent.	Analysis of Sample Sent by Manufacturers.								Guarantee of Manufacturers,						
		Total Phos. Acid, per cent	Soluble Phos. Acid, per cent	Reverted Phos. Acid, per cent	Available Phos Acid, per cent	Insoluble Phos Acid, per cent	Nitrogen, per cent.	Potash, per cent.	Valuation per Ton.	Valuation per Ton.	Total Phos. Acid, per cent.	Available Phos Acid, per cent.	Nitrogen, per cent.	Potash, per cent.	Excess of Valuation by Analysis.	Deficiency of Valuation by Analysis.
Baugh's Double Eagle Phosphate	Baugh & Sons Company, Baltimore, Md	11.56	6.82	1.75	8.57	2.99	2.18	......	$24.93	$22.42	11.00	8.00	2.06	....	2.51	....
Baugh's Dissolved S. C. Rock...	" "	14.15	9.07	3.51	12.58	1.87	....	....	21.25	22.00	15.00	13.00	......	....	....	.75
Baugh's Pure Raw Bone Meal....	" "	21.09	....	....	....	....	4.19	......	36.20	33.78	21.00	......	3.30	......	2.42	....
Baker's Special Wheat, Corn and Grass Mixture........	The Chemical Company of Canton, Baltimore, Md	11.71	6.06	2.26	8.32	3.39	1.04	1.99	21.28	19.85	10.00	9.00	.75	2.00	1.43	....
Pure Dissolved S. C. Bone........	" "	14.42	13.97	.31	14.28	.14	......	....	22.92	22.60	15.00	13.00	....	....	.32	....
Standard Phosphate	Lister's Agricultural Chemical Works, Baltimore, Md	12.11	7.56	2.67	10.23	1.88	2.58	1.28	28.68	26.43	10.00	10.00	2.35	1.50	2.25	....
Harvest Queen.........	" "	12.91	7.29	2.17	9.46	3.45	1.92	1.16	25.62	21.41	10.00	10.00	1.03	1.50	4.21	....
U .S. Phosphate.........	" "	11.04	6.21	2.60	8.81	2.23	1.97	2.39	25.31	18.21	7.00	7.00	1.32	2.00	7.10	....
Ammoniated S. C. Bone...........	Greenbrier Meat and Fertilizer Co., Roncevert, W. Va.........	9.43	7.68	1.62	9.30	.13	.16	......	15.5[illegible]	36.62	16.30	14.30	3.30	....	....	21.06
Dissolved S. C. Bone......	"	14.26	12.37	1.67	11.01	.22	....	......	22.59	24.08	16.30	14.30	....	......		1.49
S. C. Phosphate......	I. P. Thomas & Son Co., Philadelphia, Pa	15.59	12.09	2.01	11.10	1.49	....	....	23.45	22.00	15.00	13.00	....	...	1.45	....
Ground Bone..	" "	21.37	....	...	..	......	3.63	....	38.68	37.22	23.00	......	3.70		1.46	....
Farmers' Choice................	" "	10.83	7.27	2.22	9.49	1.34	1.78	2.05	24.80	23.87	11.50	9.50	1.44	2.00	.93	....
Normal	" "	9.95	5.24	3.32	8.56	1.39	1.18	2.00	21.01	20.21	10.50	8.50	1.03	1.50	.80	....
Improved	" "	13,55	9.62	2.59	12.21	1.31	.52	....	23.11	21.95	14.00	12.00	.41	....	1.16	......
Dissolved S. C. Bone	Liebig Manufacturing Co., New York City....................	15.02	13.48	.90	14.38	0.64		....	23.39	23.00	15.00	14.00	......	.	.39	....
High Grade Acid Phosphate......	" "	15.52	12.07	2.31	14.38	1.14	....	......	23.63	21.40	14.00	13.00	.... ..	... .	2.23	....
Sun Ammoniated Super Phosphate	" "	13.05	0.96	9.46	10.42	2.63	1.05	.81	23.05	20.71	11.00	10.00	.82	1.00	2.34	....
Plow Brand Raw Bone Super Phosphate	Walten & Whann Co., Wilmington, Del	12.50	6.56	2.45	9.01	3.49	2.42	1.85	27.55	27.57	12.50	9.20	2.27	2.25	....	0.02
XX Acid Phosphate	" "	15.53	9.45	3.85	13.30	2.23	....	....	22.61	22.07	15.40	12.81	....	....	.54	....
Diamond Soluable Bone...........	" "	14.52	7.83	3.58	11.41	3.11	.34	....	21.41	23.12	15.15	12.70	0.35		. ...	1.71
Powell's Red Bag Fertilizer	W. S. Powell & Co., Baltimore, Md	9.97	7.74	.54	8.28	1.69	1.01	1.48	19.56	19.50	8.00	7.00	1.50	2.00	0.06	....
Dissolved S. C. Bone.............. ...	" "	16.07	13.10	2.08	15.18	.89	......	....	24.81	21.40	14.00	13.00	......	... ...	3.41	....
Capital Bone Potash......	S. W. Travers & Co., Richmond, Va......................................	12.06	5.72	3.01	8.73	3.33	....	2.40	18.36	18.60	11.00	10.00	....	2.00	....	0.24
Standard Acid Phosphate........	" "	15.55	11.72	2.01	13.73	1.82	....	....	23.66	21.00	14.00	13.00	....	....	1.66	....
Capital Dissolved S. C. Bone	" "	13.40	7.89	2.56	10.45	2.95	....	....	18.19	17.20	12.00	10.00		....	1.29	....
Beef, Blood and Bone	" "	12.08	7.17	1.98	9.15	2.93	1.76	1.15	24.2[illegible]	20.67	9.00	8.00	1.65	1.00	3.56	....
Ober's Farmers' Standard Ammoniated Phosphate.........	G. Ober & Sons Co., Baltimore, Md..	12.46	6.99	3.05	10.04	2.42	2.05	1.93	27.23	21.77	10.00	8.00	1.65	1.50	5.46	....

Name of Brand	Address of Manufacturers or General Agents.	Analysis of Sample Sent by Manufacturers.								Guarantee of Manufacturers.						
		Total Phos. Acid per cent.	Soluble Phos. Acid per cent.	Reverted Phos. Acid per cent.	Available Phos Acid per cent.	Insoluble Phos Acid per cent.	Nitrogen, per cent.	Potash, per cent.	Valuation per ton.	Valuation per ton.	Total Phos. Acid per cent.	Available Phos Acid per cent.	Nitrogen, per cent.	Potash, per cent.	Excess of Valuation by Analysis.	Deficiency of Valuation by Analysis.
Ober's Sol. Ammoniated Super Phosphate of Lime	G. Ober & Son's Co., Baltimore, Md	12.15	7.79	1.63	9.42	2.73	2.16	1.73	$26.61	$22.78	10.00	8.25	1.85	1.50	3.86	....
Ober's Dissolved Bone Phosphate S. C.	" "	15.84	10.45	3.51	13.96	1.88	....	....	23.46	22.00	15.00	13.00	....	....	1.46	....
Ober's Shawnee Ammoniated Phosphate	" "	11.15	6.30	3.10	9.40	2.15	1.68	2.39	20.40	21.77	10.00	8.00	1.65	1.50	....	1.37
Superior Bone	The Cleveland Dryer Co., Cleveland, Ohio	23.11	....	....	....	..	4.11	....	37.41	36.11	22.00	....	3.71	....	1.37	....
Square Bone	" "	14.93	2.96	4.68	7.64	7.29	1.79	....	26.84	27.38	20.00	6.00	2.47	.....	....	0.54
Ohio Seed Maker	" "	13.39	6.63	3.99	10.62	2.77	1.30		23.59	23.67	15.00	10.00	1.23	....	....	0.08
Buckeye Ammoniated Super Phosphate	" "	13.51	5.81	3.14	9.25	4.26	1.87	......	23.59	24.98	11.00	9.00	2.47	....	......	1.39
XXX Phosphate	" "	16.00	9.17	3.17	12.34	3.66	....	....	21.93	23.00	15.00	14.00	....	....	....	1.07
*Farmers' Favorite	Baltimore Pulverizing Co., Baltimore, Md	6.38	2.41	2.79	5.20	1.18	1.30	1.87	15.83	10.78	5.50	4.25	0.82	.12	5.05	....
Special Mixture	R. A. Alexander, Charleston, W. Va	11.73	7.80	1.87	9.67	2.06	1.28	1.44	23.01	17.30	... ...	7.50	1.00	1.50	5.71	....
Wheat, Oats and Barley Phosphate	The Milson's Rend'g. and Fertilizing Co., Buffalo, N. Y	14.28	8.99	3.02	12.01	2.27	2.62	2.93	33.46	22.37	10.00	8.00	1.65	2.00	11.19	....
Dissolved S. Carolina Bone	The Bradley Fertilizer & Chemical Co., Baltimore, Md	14.84	9.94	2.64	12.58	2.26	......	....	21.48	21.40	14.00	13.00	....	....	0.08	....
Dissolved S. Carolina Bone	Susquehanna Fertilizer Co., Baltimore, Md	15.17	11.53	2.37	13.90	1.27	......	....	23.00	22.00	15.00	13.00	....	....	1.00	....
Special Wheat and Grass	P. S. Chappell & Sons, Baltimore, Md	9.16	6.46	1.49	7.95	1.21	1.34	2.09	20.62	22.81	....	8.50	1.24	4.50	....	2.19
Globe Dissolved Bone	Lorentz & Rittler, Baltimore, Md	11.33	4.41	3.27	7.68	3.65	1.01	1.53	19.84	20.71	11.00	10.00	.82	1.00	....	.87
Dissolved S. Carolina Bone	" "	16.09	11.40	3.30	14.70	1.39	....	....	24.35	22.00	15.00	13.00	....	....	2.35	....
Miller's Standard Ammoniated Bone Phosphate	Susquehanna Fertilizer Co., Baltimore, Md	10.65	7.21	2.16	9.37	1.28	1.09	1.43	21.31	19.16	10.00	8.00	1.03	1.25	2.15	....
Shenandoah	Valley Vertilizer Co., Charleston, W. Va	11.36	4.51	1.68	6.19	5.17	2.25	....	21.55	20.57	....	8.00	1.65	1.50	.98	....
Keystone Dissolved Bone Phosphate	S. W. Hess & Brother, Reading, Pa	12.48	8.97	1.93	10.90	1.58	1.24	1.40	24.50	18.70	9.00	9.00	1.00	0.50	5.80	....
High Grade Acid Phosphate	" "	15.57	11.12	3.44	14.56	1.01	....	....	23.90	19.20	12.00	12.00	....	....	4.70	....
†Chesapeake Guano	The Chesapeake Guano Co., Baltimore, Md	17.39	5.66	5.62	11.28	6.11	1.11	.31	26.24	....	....	....	....	....	†	†
‡Dissolved Bone Phosphate	" "	13.72	9.26	4.01	13.27	0.45	....	....	21.95	....	....	. .	....	....	†	†

Name of Brand.	Address of Manufacturer or General Agent.	Analysis of Sample Sent by Manufacturers. Total Phos. Acid, per cent.	Soluble Phos. Acid, per cent.	Reverted Phos. Acid, per cent.	Available Phos. Acid, per cent.	Insoluble Phos. Acid, per cent.	Nitrogen, per cent.	Potash, per cent.	Valuation per Ton.	Guarantee of Manufacturers. Valuation per Ton.	Total Phos. Acid, per cent.	Available Phos. Acid, per cent.	Nitrogen, per cent.	Potash, per cent.	Excess of Valuation by Analysis.	Deficiency of Valuation by Analysis.
Pure Raw Bone	Walter Stratman & Co., Allegheny, Pa	22.12	......	......	......	......	3.74	..	$29.97	$34.98	22.00	......	3.30	......	......	3.01
Four Fold	" "	8.39	2.26	3.84	6.10	2.29	1.02	.68	15.68	13.58	7.00	6.00	.82	.27	2.10	...
Big Bonanza	" "	11.48	7.11	1.94	9.05	2.43	1.43	.80	22.17	24.82	12.00	11.00	1.65	.35	.	2.65
Dissolved Bone	The Raisin Fertilizer Co., Baltimore, Md	13.93	6.19	5.05	11.24	2.69	2.48	......	29.02	26.40	13.00	11.00	2.00	......	2.62	......
Empire Guano	" "	10.95	6.05	1.46	7.54	2.41	1.90	1.56	22.53	24.35	10.00	9.00	2.00	1.75	......	1.82
Acid Phosphate or Dissolved S. C	" "	14.93	11.07	2.99	14.06	0.87	0.06	......	23.23	23.76	15.00	14.00	.20	......	......	0.55
Garden City Super Phosphate	The N. W. Fertilizing Co., Chicago, Ill	12.20	2.98	3.84	6.82	5.38	2.36	.99	24.09	23.56	12.00	8.00	2.06	0.54	0.53	......
Horse Shoe Brand Fine Raw Bone	" "	23.00	......	......	......	......	3.69	......	37.19	34.98	22.00	......	3.30	......	2.21	......
Pied. Dissolved Phosphate	The Mt. Airy Mfg. Co., Baltimore, Md	10.63	6.63	3.01	9.64	99	......	.94	16.95	17.80	10.50	..	......	1.00	......	0.85
P. G. Ammoniated Super Phosphate	" "	9.79	3.05	4.53	7.58	2.21	1.15	.82	18.64	18.74	8.00	......	1.30	1.00	......	.10
Mt. Airy Alkaline Dissolved Bone Phosphate	" "	8.10	2.32	4.65	6.97	1.13	......	1.21	13.07	14.05	8.00	......	..	1.25	.	.98
Pied. Raw Bone Mixture	" "	8.40	......	......	......	......	3.45	.79	15.56	15.50	7.00	......	.87	1.00	......	.06
Baltimore Soluble Bone	The Baltimore Guano Co., Baltimore, Md	15.50	9.00	4.38	13.38	2.12	.25	......	23.63	21.40	14.00	13.00	......	......	2.23	......
Game Guano	" "	11.64	6.26	2.32	58	3.06	2.07	2.27	25.70	25.10	10.00	9.00	2.00	2.50	.60	......
B. G. Ammoniated Bone Phosphate	" "	11.49	5.78	2.56	8.34	3.15	38	2.07	22.54	19.96	9.00	8.00	1.20	2.00	2.58	......
Defiance Bone	" "	13.23	8.45	3.00	11.45	1.78	. .	2.39	21.77	20.20	12.00	11.00	......	2.00	1.57	......
Excelsior Plant Food	The Ramsburg Fertilizer Co. Frederick, Md	12.65	8.35	1.62	9.97	2.68	2.44	.94	27.76	23.85	12.00	9.00	1.75	1.00	3.91	......
Dissolved Bone Super Phosphate	" "	15.12	8.74	3.84	12.58	2.54	......	......	21.65	20.40	14.00	12.00	...	......	1.25	......
Star Brand Guano	Allison & Addison, Richmond, Va.	11.05	7.34	1.51	8.85	2.20	2.15	1.18	23.65	20.92	9.00	8.00	1.65	1.25	2.73	......
Acid Phosphate	" "	13.79	8.82	3.63	12.45	1.34	......	......	20.72	19.80	13.00	12.00	......	......	.92	......
Dissolved S. C. Bone Phosphate	R. J. Baker & Co., Baltimore, Md	14.64	10.26	3.53	13.79	.85	......	......	22.57	22.40	14.00	14.00	......	......	.17	......
Ammoniated Bone Super Phosphate for wheat	" "	12.21	8.51	5.50	9.01	3.20	1.78	1.39	24.49	21.88	8.50	8.50	1.85	1.25	2.61	......

Name of Brand.	Address of Manufacturers or General Agent.	Analysis of Sample Sent by Manufacturers. Total Phos. Acid, per cent.	Soluble Phos. Acid, per cent.	Reverted Phos. Acid, per cent.	Available Phos Acid, per cent.	Insoluble Phos Acid, per cent.	Nitrogen, per cent.	Potash, per cent.	Valuation per Ton.	Guarantee of Manufacturers. Valuation per Ton.	Total Phos. Acid, per cent.	Available Phos. Acid, per cent.	Nitrogen, per cent.	Potash, per cent.	Excess of Valuation by Analysis.	Deficiency of Valuation by Analysis.
Zell's Dissolved S. C. Bone	The Zell Guano Company, Baltimore, Md	15.78	11.06	2.57	13.63	2.15	....		$23.09	$22.10	...	14.00	....	.....	0.69	....
Zell's Calvert Guano	" "	13.04	8.71	2.18	10.92	2.12	0.83	1.26	23.15	18.95	11.00	9.00	.62	1.00	4.20	....
Zell's Economizer	" "	12.44	8.04	2.22	10.86	1.58	1.16	1.22	23.95	19.71	11.00	9.00	.82	1.00	4.24	....
Zell's Dissolved Bone Phosphate	" "	16.98	12.58	3.11	15.69	1.28	....	....	25.87	22.00	15.00	13.00	....	....	3.87	....
Half and Half	John S. Reese & Co. Baltimore, Md	13.12	1.59	9.35	10.94	2.18	0.88	0.29	22.44	21.31	....	11.00	.82	.60	1.13	....
	" "	14.50	11.85	2.50	11.35	.15	....	....	23.05	21.20	....	13.25	....	....	1.85	....
Reese's Dissolved Bone Phosphate	Maryland M'f'g. Company	10.76	6.76	1.83	8.59	2.17	1.85	1.91	23.98	23.53	10.00	9.00	1.85	1.50	0.45	....
Ammoniated Bone																
The Globe Complete Manure	"	11.81	6.25	1.56	7.81	4.00	1.50	1.75	22.34	21.97	10.00	9.00	1.44	1.50	0.37	....
Dissolved Animal Bone	"	14.83	8.68	4.16	12.84	1.99	2.15	....	29.90	31.42	16.00	14.00	2.06			1.52
Tornado Fertilizer	" "	11.77	7.76	2.36	10.12	1.65	.67	....	23.63	23.00	12.00	11.00	0.41	3.25	0.63	.....
Linden Super Phosphate	"	10.10	6.74	2.93	9.67	.43	....	2.83	18.56	18.60	11.00	10.00	....	2.00	.....	.04
Dissolved Phosphate	" "	14.72	11.48	2.65	14.13	.59	....	....	22.96	....	14.00	13.00	....	...	1.56	....

†This firm failed to send us their guarantee.

*Corbonate of lime found 30.65 per cent. Carconate of lime 35 per cent. claimed.

We place no valuation upon ground oyster shells, as we are not informed as to their real commercial value Their value, whatever it may be, should be added to the above.

It will be observed by comparing the valuations as shown by the analyses of samples sent in by the munufacturers with the valuation based upon the analyses guaranteed by them that about 27 per cent. fall short of their guarantee. The most notable case of deficiency is that of the Greenbrier Meat & Fertilizing Co., in which the valution of their Ammoniated S. C. Bone, compared with their guarantee, falls short $21.06 per ton. Their Dissolved S. C. Bone falls short $1.49 per ton. It is evident that the above named company *either does not know what it is manufacturing, or else is misrepresenting the quality of its goods.*

This is the first season that the law "Concerning Commercial Fertilizers" went into effect, and some of the manufacturers were apparently unacquainted with its provisions until the season was upon them. Hereafter, we shall endeavor to have all samples analyzed and the analyses published and distribated by the time the goods are upon the market and the manufacturers have been notified that the fertilizer inspection of each year, under the provisions of the law, begins with January 1st. The inpection this year covered only the fall trade; hereafter it will cover both spring and fall trade. It is also our purpose to collect samples of the goods as delivered in various parts of the State for analysis, and publish the analyses as a supplemental bulletin.

Manufacturers and farmers are urged to exercise care in sending in samples for analysis, as we have no official knowledge of the various brands except as represented by the samples in our hands.

Our analyses are made with the utmost care, and every source of error that we are able to detect in our methods is carefully eliminated. All of our work is done with a view to being perfectly impartial, and the Chemist, in making the analysis, analyzes the fertilizers by number without knowing the claims of the manufacturer. It is not desired to injure legitimate trade, but to protect responsible and honest purchasers and reliable and trustworthy manufacturers.

We hope in the near future to see an improvement in the quality of fertilizers sold in the State and a large reduction of the number of brands falling below the guarantee of the manufacturers.

Before this law went into effect this State was undoubtedly made the dumping ground of a large amount of low grade goods, but we hope to see them disappear from our markets by the beginning of our next fertilizer season.

JOHN A. MYERS.

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Bulletin No. 19

WEST VIRGINIA

Agricultural Experiment Station

MORGANTOWN, W. VA.

YOUR WEEDS AND YOUR NEIGHBOR'S.

PART I.

WEEDS AS FERTILIZERS.

NOVEMBER, 1891.

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YOUR WEEDS AND YOUR NEIGHBORS.

C. F. MILLSPAUGH, M. D.,

BOTANIST.

In closing Bulletin 12, issued in December, 1890, I promised the farmers of West Virginia, that if they would assist me by answering some questions that I there subjoined, I would issue for their consideration a bulletin giving them the results of my investigations upon the subject of bettering our farms by diminishing the annual weed crop, and give them the benefit of such answers as I might receive from themselves and their neighbors.

The large number of painstaking answers received, and the diversity of material contained therein, together with the vast number of questions asked in return, and my own observations; results in such a large amount of material, that it is deemed advisable to issue the bulletin in parts as follows:

Part 1. Weeds af Fertilizers, (now before you.)
Part 2. Descriptive List of our Weeds.
Part 3. Distribution and Bad Points of our Weeds.
Part 4. General Treatment of Weedy Fields.

This series will be printed in a uniform manner, each part depending more or less upon the other, and references will be made from one to the other throughout; it would therefore be well for those interested in this subject to keep the parts together as issued, that such references may readily be made, as I shall aim to so completely treat this subject that farther publications upon weeds will be unnecessary in this State.

By a weed I shall be understood to mean: **Any plant that seeks to grow where it is not wanted by him who utilizes the soil,** no matter for what purpose.

To one speaking or writing upon this subject, the greatest difficulty he has to contend against is the variety of names any one weed may be known by in different localities. Hardly a weed, except a very few of the most common types, is generally known by a single name, and a large amount of descriptive labor is usually required, to satisfy all ones readers or listeners as to just what plant is meant when a given name is mentioned. I hope to avoid most of this confusion by issuing Part 2, but to be fully understood by the reader of any locality I shall be compelled to use at times the botanical or scientific name, which remains the same before all people and in all languages, and when used can never be misunderstood. I shall however use such names parenthetically and as little as is consistent with a full understanding of the matter, and hope that those who find them confusing or in any way obtrusive will simply skip them, as the sentences in which they occur are so constructed that they will read as well to the general mind if these names are omitted.

WEEDS AS FERTILIZERS.

All plants during the process of their growth extract from the earth and air such elements of food as they may require for their subsistence, or failing to do so droop and die, or fail to reach maturity. It is just as essential to weeds to be properly fed as it is to crops, as far as the plants themselves are concerned; they therefore extract from the soil their due proportion of those food ingredients necessary for the proper growth and productiveness of paying crops. This being true, the question naturally arises: How shall we return to the soil those food elements of which it has been robbed by useless vegetation?

Every plant, no matter of what nature, that is gathered and removed from the field in which it grew, takes with it more or less of the food needed by the next plants to be grown thereon. In order then that the next growths shall properly mature, it is absolutely necessary that we return to that soil not only the principal loss but the other factors in plant life as well. This will explain why the use of Commercial Fertilizers alone, is so often denounced by farmers. These substances only aim to return to the land the three principal matters taken up in plant life, Potash, Phosphoric Acid, and Nitrogen. They in no wise tend to return the humus so necessary to cause the mineral elements to become available to the plants. This must be in the soil or supplied to it, if not there naturally. The only way in which it can be properly placed there is the natural way, that is by the decay of vegetable matter.

If, therefore, we expect to obtain a proper yield from any piece of land that has been previously cropped, we must return to it decayed vegetable matters, or allow it to rest in good sod. By doing so, we will never have cause to complain of sour or worn out fields.

The compost heap is, or should always be, the farmers most trustworthy bank. A bank only to be embezzled by lack of watchfulness and care on the part of the owner himself. In this bank, interest compounds itself, and deposits of worthless stock turn to available tender. Here should be placed to the credit of the farm every refuse thing of animal or of vegetable origin that can be found about the place, especially every weed of the field and roadside. The only bad result that I can foresee from this method, is the fear that the farmer who once realizes by practice what a valuable investment this compost heap is, may become covetous of his neighbor's weeds and be tempted to steal them.

In order to determine as nearly as possible the actual money value of weeds as fertilizing material upon the basis of "complete fertilizers." I gathered about fifty well known species, all that could be handled conveniently by our Chemist; who afterward subjected them to careful analysis. The result of these analyses, given below, convinces me of the value of these plants as fertilizers; and serves to show first, how much robbery they commit, and second, how much loss the farmer sustains who does not reclaim from them that which has been stolen.

In the following list of analysed weeds, the value of each per dry ton is expressed simply upon the basis of the commercial value of each constituent mentioned. When properly composted the actual value of each weed, (taking into account the quality the resulting humus has of rendering these mineral ingredients available as plant food,) per green ton is worth fully the figures given:

Name.*	Nitrogen.	Phos. ac.	Potash.	Value.
Poke-weed. (*Phytolacca decandra, L.*)	3.34	.65	8.00	$21.93
Bitter Dock (*Rumex obtusifolius, L.*)	2.94	.50	4.29	16.26
Common Thistle (*Cnicus lanceolatus, (L.) Willd.*)	2.44	.62	5.53	15.79
Crow-foot Grass (*Panicum sanguinale, L.*)	1.89	.90	4.67	13.39
Sheep Sorrel (*Oxalis corniculata* v. *stricta. (L.) Sav.*)	2.04	.61	3.02	12.74
Fox-tail Grass (*Setaria glauca, (L.) Beauv.*)	1.77	.75	4.52	12.41
Pleurisy-weed (*Asclepias tuberosa, L.*)	2.02	.86	3.31	12.35
Sweet Clover, Bokhara Clover. (*Melilotus alba, L.*)	2.40	.50	1.95	11.87
Burdock (*Arctium Lappa, L.*)	1.85	.96	3.07	11.69
Ox-eye Daisy (*Chrysanthemum Leucanthemum, L.*)	2.12	.46	2.88	11.66

*Dr. DeRoode is responsible for the analyses, and Dr. Millspaugh for the calculations of the valuations.

John A. [illegible]

Name.	Nitrogen.	Phos. Ac.	Potash.	Value.
Horse weed, Wild Lettuce (*Lactuca Canadensis, L.*)	1.07	.47	2.20	11.53
Wild Carrot (*Daucus Carota, L.*)	1.65	.62	4.21	11.47
Butter weed (*Lactuca leucophaea (Willd.) Gray*)	2.06	.52	2.89	11.44
Deer-tongue Grass (*Panicum clandestinum, L.*)	1.95	.76	2.90	11.44
Blue Thistle (*Echium vulgare, L.*)	1.45	.80	4.56	11.35
Iron weed (*Vernonia Noveboracensis, (L.) Willd.*)	2.07	.42	2.11	10.63
Clot-bur (*Xanthium strumarium, L.*)	1.51	.73	3.45	10.43
Climbing Buckwheat (*Polygonum dumetorum, scandens (L.), Gray.*)	1.93	.40	2.31	10.38
Yarrow (*Achillea Millefolium, L.*)	1.71	.50	2.98	10.28
Wild Flax, Toad Flax (*Linaria vulgaris, Mill.*)	1.83	.64	2.30	10.27
Lobelia, Indian Tobacco. (*Lobelia inflata, L.*)	1.79	.65	2.35	10.11
Stickweed, White Devil, (*Aster lateriflorus (L.), Britt.*)	1.92	.56	1.61	9.80
Briars, (*Rubus villosus, Ait.*)	1.51	.32	.74	9.68
Wing-Stem, (*Actinomeris alternifolia (L.), DC.*)	1.40	.94	2.73	9.55
Old White-top, Velvet-grass. (*Holcus lanatus, L.*)	1.30	.45	3.72	9.38
Boneset, (*Eupatorium perfoliatum. L.*)	1.70	.53	1.94	9.23
Timothy, (*Phleum pratense, L.*)	1.48	.63	2.65	9.21
Milk-weed, Wild Cotton, (*Asclepias Syriaca, L.*)	1.71	.93	.78	8.77
Blue Devil, (*Aster cordifolius, v. laeviagatus, Porter*)	1.49	.52	2.25	8.74
Wild Coreopsis, (*Coreopsis triptris, L.*)	1.56	.48	1.54	8.22
Nail-rod, Stick-weed, (*Aster lateriflorus, var hirsuticaulis, Gr.*)	1.47	.49	1.83	8.20
Wire-grass, (*Eatonia Pennsylvanica (Spr.) Gray*),	1.32	.52	2.26	8.10
Red-top, (*Agrostis alba, var. vulgaris (With) Thurb*)	1.39	.40	2.10	8.02

Name.	Nitrogen.	Phos. Ac.	Potash.	Value.
Quill-weed, Queen-of-Meadow. (*Eupatorium purpureum, L.*)	1.41	.36	1.81	7.83
Canada Thistle, (*Cnicus arvensis* (*L.*), *Hoffm*)	2.06	.45	2.74	7.58
Sorrel, (*Rumex Acetosella, L.*)	1.38	.21	1.89	7.47
Indian Hemp, Rheumatism-weed (*Apocynum androsaemifolium, L.*)	1.60	.44	.69	7.47
Elders, *Sambucus Canadensis, L.*)	1.56	.31	1.00	7.41
Rag-weed, *Ambrosia artemisiaefolia, L.*)	1.36	.41	1.79	7.32
Goldenrod, (*Solidago juncea, Ait.*)	1.27	.39	1.62	7.15
Spanish Needles, (*Bidens frondosa, L.*)	1.24	.32	1.92	7.14
Orchard Grass, (*Dactylis glomerata, L.*)	.95	.54	2.61	7.08
Naked-weed, Skeleton-weed, (*Chondrilla juncea, L.*)	1.13	.74	1.27	6.74
Oat-grass, (*Danthonia spicata* (*L.*) *Beauv.*)	1.13	.28	1.77	6.50
Old-field Balsam, (*Gnaphalium obtusifolium, L.*)	1.04	.41	1.75	6.35
Evening Primrose, Wild Beet, (*Oenothera fruticosa, L.*)	1.05	.39	1.68	6.29
Blue-joint, (*Andropogon provincialis, Lam.*)	.73	.24	1.29	4.44
Broom Sedge, (*Andropogon scoparius, Michx.*)	.78	.21	.68	3.68
Panicled Panic-grass, (*Panicum virgatum, L.*)	.60	.28	.68	3.40

GATHERING WEEDS FOR COMPOSTING. The best time of the season to cut from the meadow and pasture, as well as from the road side and unused field, the weeds that have sprung up and grown thereon, happens, luckily for the farmer, to be that period following harvesting of his grain; when, if ever, he has the time to so expend, while his men and teams are comparatively free for such use, and the majority of the weed seeds are not yet mature.

About the last of July, then, give the boys weed-scythes and set them at the road-sides, ditches and fence-rows; the older hands with brush-scythes and mattocks can go over the neglected fields and prepare them for the mowing-machines, by first removing the stiffer growths; then the mower and horse-rake can soon gather a valuable mass of heretofore worthless vegetation, and the teams will haul it to the place it may be judged best to build the compost heap. Should any field have a bad growth of cinquefoil and running briars,

drop the guard-points of the mowing-machine sufficient to catch them up, and it will thoroughly cut over the field.

The question may be raised, why not burn the weeds after they have been raked up in wind rows? Should this be done one good effect would be gained, the killing of the seeds; but the farm would lose in that way the most valuable qualities of the weeds, the nitrogen and the humus.

Another question. Why not let them rot as they lay, and not be to the trouble of hauling and handling them over? This method would have two ill effects. First: the rotting would be incomplete, and the weeds would give off to the air most of their nitrogen; thus losing an average of nearly three quarters of their value. Second: many weeds will mature their seeds after being cut down, thus being able to perpetuate their presence upon the farm.

Still again it will be asked. Why not plow them under and let them rot in the soil. This method is a good one, especially with small or succulent weeds, and will be treated of fully in Part 4, but we are dealing with the weeds of those fields that are not intended for immediate cultivation, and with those spots upon all farms where cultivation is not carried on.

Only one question more remains to be answered, one that I hope will never be asked. Why not leave the weeds entirely alone, and let them fall in their places, they surely will do some good to the soil? True they would, and go on increasing and multiplying forever to the great detriment of the farm and neighborhood.

Where to build the Compost Heap. This will depend upon two particular points: First, where the resulting compost is to be spread when ripe. Second, whether chemicals or stable lye is to be used to aid in the rotting of the heap. If plaster (sulphate of lime) is to be used in the heap it may be built in or near the field where it is anticipated to utilize it. When manure, and especially stable liquor, is to be used, then the heap should be built in the barn-yard, as near as is convenient to the source of supply.

Method of Building the Field Heap. Select that point nearest the field upon which the material is to be used, that will, if possible, be near a source of water, in order in very dry periods that water can be thrown upon the mass without too much labor. Lay upon the ground a base of old fence rails, thick poles, or other timber that will allow of a circulation of air under the base of the heap. Upon this pile, throw a load of weeds and scatter over them about 100 pounds of plaster per ton; place another load of weeds on this and its proportion of plaster, and so on until the heap is large enough for the field or fields upon which it is to be used, or until the material is used up. Cover the heap when built to the extent desired, with earth or turf, as you please, turf being best. Note at the end of five days if the heap is wet; if not, throw on water if possible to assist the process of decomposition, but not enough to cause it to leach through. A heap thus formed will be ripe enough for use any time after two month's standing.

These field heaps may be built and prove valuable without the

plaster, especially if good stable manure is mixed in with the weeds. The plaster however is cheap, very cheap compared with the result gained by its use, and tends to more completely rot the seeds, as well as to kill injurious larvae, and fungi.

METHOD OF BUILDING THE BARN-YARD HEAP. Select that part of the barn-yard that will give a clay base if possible, and where eaves will not discharge upon the heap. Dig a pit about 12 or 18 feet square, about a foot or eighteen inches deep. At the lowest grade point of this pit and just outside its limits, sink a hogshead or other convenient receptacle, to catch the leachings from the pit; from which they can again be thrown upon the pile, at convenient periods. Lay in this pit rails or other supports as for the field heap. Build up with weeds and stable manure as before, and drench frequently with all such liquors as can be caught from stables and old manure heaps. This heap will rot rapidly and form very valuable manure, at litte cost. Additions may be made to this heap as follows, all of which will add to its value.

Any vegetable substance used for bedding stalls, or dry earth that has been used for that purpose and become saturated more or less with stable moistures. Sawdust, shavings, leaves, straw, peat, weedy hay, etc. Soot from chimneys, wood ashes, small animals found dead about the farm, refuse hair, the meat from the carcasses of dead animals, (the bones, after soaking them a few days in sulphuric acid, should be thrown on, liquor and all), refuse corn stalks after feeding, and in fact all animal and vegetable wastes that can be gathered. It would be an excellent plan to keep a barrel sitting on an old sled by the kitchen door into which could be thrown all the household slops, dish and wash waters, etc. This could be periodically emptied upon the heap to great advantage. Finally and richest of all, the droppings from under the poultry roosts, should be treasured as gold.

I have treated this subject from the standpoint of a Botanist only and have trespassed as little as possible upon the domains of our Chemist and Agriculturist. These members of the staff will soon issue bulletins upon Fertilizers and the best methods of their use, as well as upon Composts, their construction and value. My desire in this bulletin having been simply to show that at least one method of eradication of weeds, will result in profit to the full value of the labor expended.

By following the paying procedures here set forth the farmer will gain:

1. The plant food of which the weeds have robbed the soil.

2. A decrease of weeds the following season in direct proportion to the countless thousands of weed seeds that this process properly carried out will destroy.

3. Fields easier to work, and crops cheaper to cultivate.

4. Cleaner pastures, with more room for good grass.

5. Sleek stock yielding better milk and beef.

6. Healthier homes and cleaner surroundings.

All of which will give him an enviable name for neatness, and his farm an appearance of thrift and prosperity.

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WEST VIRGINIA

Agricultural Experiment Station

MORGANTOWN, W. VA.

POTATOE CULTURE, AND FERTILIZATION,

AND

TESTS OF SOME VARIETIES OF TOMATOES.

BY

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JOHN A. MYERS, PH. D.

DIRECTOR.

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POTATOE CULTURE AND FERTILIZATION,

The primary object of this experiment was to determine the effects of kainit, used alone, and combined with phosphoric acid and nitrogen, as a fertilizer in growing potatoes; and in connection therewith, to test the production of the leading varieties, and the comparative effects which would be produced by planting the whole potatoe, the halves, the quarters and cut in pieces, each having one eye: also the effects which would be produced by doubling the amount of seed to a given space.

For this purpose I selected a piece of ground containing 83.6 square rods. This land is a yellowish-gray soil and has probably been cultivated for more than fifty years, being so completely "worn out" that there was no profit, but an actual loss in its cultivation. This land was "broken up" about the last of March, abou five inches deep, horrowed "furrowed-out" and divided into ten plats each, one rod wide and 8.36 rods long, leaving a strip between the plats three feet wide, which was not planted and to which no fertilizers were applied. These plats were planted as follows: The rows were 3.83 feet apart, running across all of the ten plats. The first twelve rows were planted with Early Rose; the second twelve with White Star, and the third twelve with Beauty of Hebron. The first three rows of each variety, except White Star, were planted with whole potatoes, three feet apart; the second three rows of all varieties were planted with halves cut lengthwise, eighteen inches apart; the third three rows of each variety with quarters, cut lengthwise, nine inches apart, and the fourth three rows of each variety were planted with pieces containing one eye each, three pieces in a hill, nine inches apart. The first row of the White Star was planted with whole potatoes three feet apart, and the second and third rows were planted with whole potatoes eighteen inches apart, the latter for the purpose of determining the effects of doubling the seed on the same amount of ground. The potatoes were planted on the 13th and the 14th days of April, 1891, and "came up" about the 1st of May. They were fertilized May 5th by applying one half of the fertilizer to the rows and by sowing the other half broadcast over the several

plats, and the ground rolled immediately thereafter for the purpose of leveling the furrows and pulverizing the clods. There was no rain from the time of planting until the 20th day of May, but was very seasonable after that time.

Some further explanation is necessary in regard to the character of the soils in the several plats. The quality and condition of the soil in plats 1, 2, 3, 4 and 5 sor far as could be determined by careful inspection was practically the same, except that part of No. 1 planted in White Star, and the first six rows of Beauty of Hebron, and that part of No. 2 in which the last six rows of Beauty of Hebron were planted was of inferior quality. That part of No. 6 on which the Early Rose were planted, and the whole of No. 7 was very poor. No. 10 was decidedly the poorest plat of all. The last three rows of the White Star variety on plat No. 9 was probably the best spot in the whole series of plats. Keeping these facts in view, we will be enabled to make a more accurate analysis of the facts presented by this experiment.

The results obtained by the experiment will be treated as follows:

1st. The comparative yield of large and small tubers of the several varieties, produced by the use of different fertilizers.

2nd. The increased yield produced by the use of different fertilizers, their cost, and profit and loss.

3rd. The comparative yeld of tubers, planted whole, in halves, quarters, and cut to one eye.

4th. The number and vigor of the stalks, produced by potatoes planted whole, and cut into halves, quarters, and single eyes.

I. The comparative yield of large and small tubers, of the several varieties, &c.

Table A. Sets forth in detail, the amount and kind of fertilizers used on each plat and the yield of large and small tubers of each variety. Although the table presents some very interesting facts, we are not prepared to say that it gives any definite data by which we can determine the effects of different fertilizers upon the size of the tubers Upon this point plats Nos. 1, 6 and 10 where Kainit alone was used, seem to contradict each other, while plats Nos. 2 and 7, also plats Nos. 3 and 8, substantially agree with each other; yet we may safely infer that the more efficient the fertilizer, the less will be the ratio of small to large tubers.

TABLE A.

Number of Plat.	FERTILIZERS APPLIED. Kainit.	FERTILIZERS APPLIED. Nitrate of Soda.	FERTILIZERS APPLIED. Acid Phosphate (S. C. Diss. Bone.)	EARLY ROSE. Large.	EARLY ROSE. Small.	EARLY ROSE. Total.	BEAUTY OF HEBRON. Large.	BEAUTY OF HEBRON. Small.	BEAUTY OF HEBRON. Total.	WHITE STAR. Large.	WHITE STAR. Small.	WHITE STAR. Total	TOTALS. Large.	TOTALS. Small.	TOTALS. Grand Total.
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
1	42.	....	....	88.	22.50	110.50	71.50	20.00	91.50	107.25	23.00	130.25	266.75	65.50	332.25
2	42.	8.34	....	89.50	18.50	108.	68.00	16.50	84.50	146.25	12.00	158.25	303.75	47.00	350.75
3	42.	....	21.	120.	20.50	140.50	145.75	19.25	165.00	202.00	13.00	215.00	467.75	52.75	520.50
4	42.	8.34	21.	108.	18.50	126.50	115.50	18.00	133.50	171.00	14.00	185.00	394.50	50.50	445.00
5	....	....	....	65.50	14.	79.50	57.50	15.50	73.00	60.25	11.75	92.00	203.25	41.25	244.50
6	31.50	....	....	52.25	12.75	65.	88.00	16.25	104.25	132.25	9.75	142.00	272.50	38.75	311.25
7	31.50	8.34	....	64.75	13.50	78.25	67.00	15.00	82.00	101.75	9.75	111.50	233.50	38.25	271.75
8	31.50	....	21.	105.75	18.	123.75	123.00	19.00	142.00	145.75	14.25	160.00	374.50	51.25	425.75
9	31.50	8.34	21.	89.25	15.	104.25	133.75	17.75	151.50	191.50	15.00	206.50	414.50	47.75	462.25
10	21.			58.75	13.50	72.25	79.25	19.75	99.00	81.00	16.00	97.00	219.00	49.25	268.

II. The increased yield produced by the use of Commercial Fertilizers and the profit and loss in the use of the same.

Table B shows the amount and cost of the fertilizers applied, the yield, the increased yield produced by the use of fertilizers, the value of the increased yield (estimating the value of the large tubers at fifty cents per bushel and the small dues at 25 cents per bushel), and the profit and loss through fertilization, of each variety on each plat; also the totals of the same, together with the increased yield, profit and loss per acre.

Taking the plats from 1 to 5 inclusive, we find that No. 5 without any fertilization, produced 244½ pounds of potatoes, while No. 1, with 42 pounds of kainit, produced 332¼ pounds. The addition of 8⅓ pounds of nitrate of soda increased the yield only 18½ pounds, while the addition of 21 pounds of S. C. dissolved bone increased the yield to 520½ pounds, or a net increase over plat No. 1 with kainit alone, of 183½ pounds, and a net increase over plat 5, with no fertilizer, of 276 pounds, or more than 113 per cent. The addition of 8⅓ pounds of nitrate of soda to the amount of fertilizer applied to No. 3, and applying it to No. 4, actually diminished the yield to 445 pounds, or a decrease below No. 3 of 74½ pounds. If we compare No. 3 with No. 8, in which the qualities and conditions of the soil were very nearly the same, we find that by a reduction of one-fourth of the amount of kainit, we reduce the yield from 520½ to 425¾ pounds, or a reduction of the increased yield of 94¾ pounds; in other words, the withholding of 10½ pounds of kainit diminished the yield 94¾ pounds. Allowing for the difference in the quality and conditions of the soil, plats 6, 7, 9 and 10 show approximately the same results, although not in so marked a degree.

The profit and loss account is fully set forth in the table and needs no further explanation.

We may safely infer from the results shown by table B:

1st. That the application of kainit alone at the rate of 800 pounds. per acre will increase the yield more than 40 per cent.

2nd. That the application of kainit at the rate of 800 pounds per acre, and S. C. dissolved bone at the rate of 400 pounds per acre, will increase the yield 115 per cent.

3rd. That the use of nitrate of soda as a fertilizer for potatoes produces no material increase in the crop.

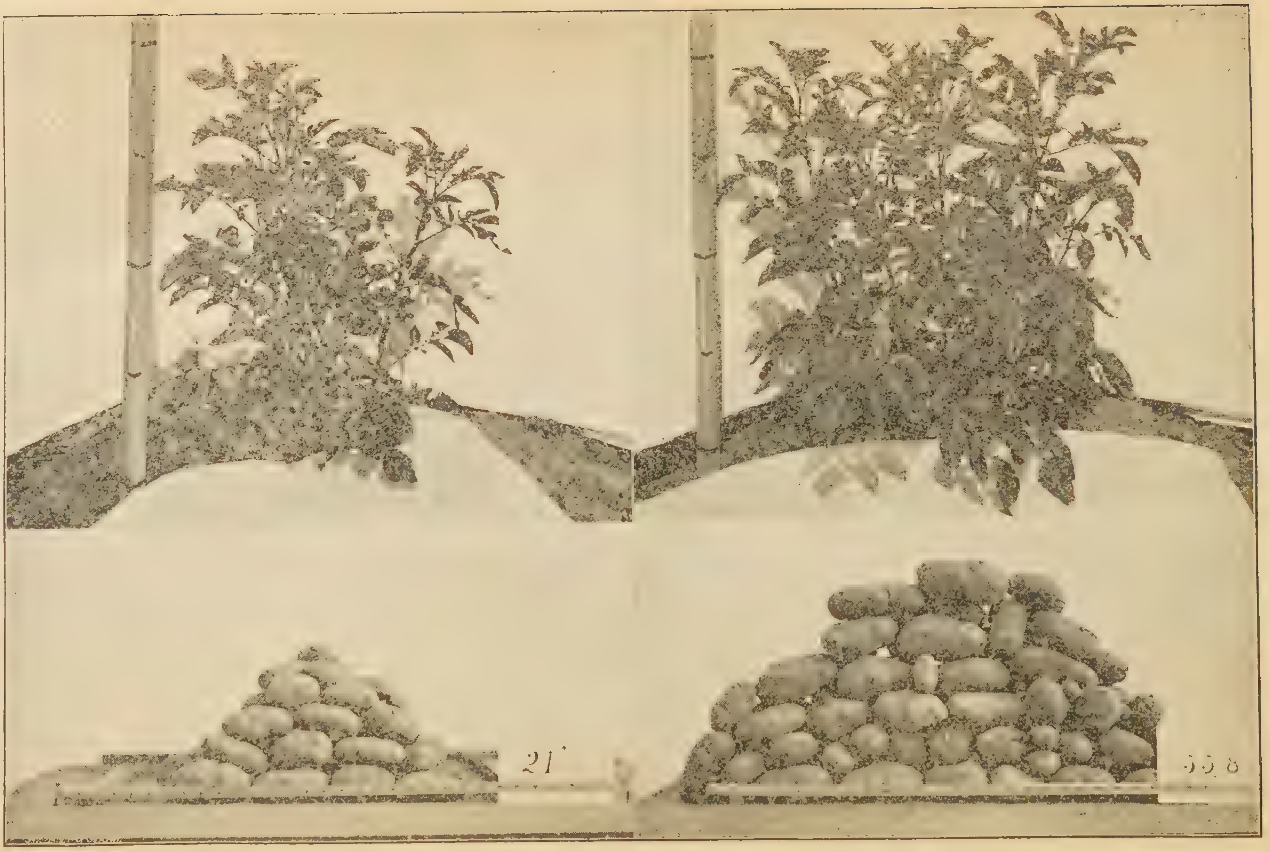
TABLE B.

Showing the Results of the Use of Commercial Fertilizers in Production, Profit and Loss.

Number of Plat.	FERTILIZERS USED.	EARLY ROSE.						WHITE STAR.					
		Yield.	Increased Yield.	Value of increased yield.	Cost of Fertilizers.	Profit.	Loss.	Yield.	Increased Yield.	Value of increased yield	Cost of Fertilizers.	Profit.	Loss.
		Lbs.	Lbs.	Cts.	Cts.	Cts.	Cts.	Lbs.	Lbs.	Cts.	Cts.	Cts.	Cts.
5	None	79.50						[illegible]					
1	12 lbs. Kainit	110.50	31.00	22.33	7.66	11.66		130.25	[illegible]	[illegible]	7.67	19.33	
2	12 lbs. Kainit and 8.33 lbs. Nitrate Soda	108.00	28.50	21.87	13.91	7.96		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
3	12 lbs. Kainit and 21 lbs. S. C. Dissolved Bone	140.50	61.00	47.90	12.42	35.48		215.00	123.00	102.00	12.48	86.58	
4	12 lbs. Kainit, 8.33 lbs. Nitrate Soda and 21 lbs. S. C. Dissolved Bone	126.50	47.00	37.29	18.67	18.62		185.00	93.00	76.56	18.67	57.88	
6	31.5 lbs. Kainit	65.00	14.50	11.56	5.77		17.32	142.00	50.00	42.50	5.77	36.73	
	31.5 lbs. Kainit and 8.33 lbs. Nitrate Soda	78.25	1.25	1.21	12.92		13.21	111.50	19.50	17.98	12.92	5.06	
8	31.5 lbs. Kainit and 21 lbs. S. C. Dissolved Bone	123.75	44.25	35.20	10.52	24.68		160.00	68.00	[illegible]	19.52	[illegible]	
9	31.5 lbs Kainit, 8.33 lbs. N. Soda and 21 lbs. S. C Dissolved Bone	101.25	24.75	20.21	16.77	3.44		206.50	114.50	94.06	16.77	77.29	
10	21 lbs. Kainit	72.25	7.25	5.83	3.83		9.66	97.00	5.00	2.37	3.83		1.46

TABLE B.—Continued.

Number of Plat.	FERTILIZERS USED.	BEAUTY OF HEBRON.						GRAND TOTAL.								
		Yield.	Increased Yield.	Value of increased yield.	Cost of Fertilizers.	Profit.	Loss.	Yield.	Increased Yield.	Value of increased yield.	Value of Fertilizer.	Profit.	Loss.	Increase per acre.	Net profit per acre	Loss per acre.
		Lbs.	Lbs.	Cts.	Cts.	Cts.	Cts.	Lbs.	Lbs.	Cts.	Cts.	Cts.	Cts.	Bus.	Dol's.	Dol's.
5	None	73.00						244.50								
1	12 lbs. Kainit	91.50	18.50	13.50	7.67	5.83		323.25	87.75	62.50	23.00	39.83		27.99	7.62	
2	12 lbs. Kainit and 8.33 lbs Nitrate Soda	84.50	11.50	9.05	13.91		4.77	350.75	106.25	86.12	41.75	44.09		32.89	8.44	
3	12 lbs. Kainit and 21 lbs. S. C. Dissolved Bone	165.00	92.00	75.01	12.42	62.68		520.25	276.00	225.00	37.25	187.75		88.05	35.93	
4	12 lbs. Kainit, 8.33 lbs. Nit. Soda and 21 lbs. S. C. Dis. Bone	133.50	60.50	49.37	18.66	30.70		445.00	200.50	163.50	56.00	107.20		67.14	20.70	
6	31.5 lbs. Kainit	104.25	31.25	25.63	5.77	19.85		311.25	66.75	56.50	17.32	39.25		21.62	7.51	
7	31.5 lbs. Kainit and 8.33 lbs. Nitrate Soda	82.00	9.00	7.71	12.02		4.29	271.75	27.25	23.58	36.06		12.44	8.69		2.37
8	31.5 lbs. Kainit and 21 lbs. S. C. Dissolved Bone	142.00	69.00	56.04	10.52	45.52		425.75	181.00	146.86	31.56	115.30		57.73	22.06	
9	31.5 lbs. Kainit, 8.33 lbs. N. Soda, 21 lbs. S. C. Dis. Bone	151.50	78.50	64.58	16.78	47.81		462.25	217.75	188.85	50.31	138.54		69.44	26.50	
10	21 lbs. Kainit	99.00	26.00	19.89	3.83	16.06		268.17	23.75	16.41	11.49	4.92		7.57	.84	



UNFERTILIZED. FERTILIZED

Photograph of Potato Plants and Tubers, Showing the Effect of Fertilization

EXPLANATION OF PLATE.

This plate was made from photographs taken by Dr. C. F. Millspaugh, Botanist of this Station. An average hill of the three rows planted with the whole potato of the White Star variety on each of the plats Nos. 3 and 5, were selected and shotographed on the 3rd day of July. During the month of October, all the potatoes produced in these three rows of plats 3 and 5, were separately and carefully dug, gathered and weighed, and piled in pyramidal form on a table and photographed. A "tape line," divided into inches, was stretched along the base of the pyramid, so that the size of the tubers, and of the pile, can easily be ascertained. The figures on the right of each pile represent the number of pounds contained therein. The rows in each plat were each one rod long and three and three-tenths feet apart, making the three rows cover three fifths of one square rod. The potatoes produced by the three rows of plat No. 3 weighed 55.8 lbs., and the plant and potatoes are represented on the right side of the picture. The potatoes produced by the three rows of plat No. 5, weighed 21 lbs., and the plant and potatoes are represented on the left side of the picture. To plat No. 5, no fertilizers whatever were applied. To plat No. 3, fertilizers were applied at the rate of 800 lbs. of Kainit, and 400 lbs. of S. C. Dissolved Bone per acre. The yield of potatoes for the unfertilized plat was at the rate of eighty-six and two-thirds bu. per acre, while the yield of the fertilized plat was at the rate of two hundred and forty-eight bu. per acre. The cost of the fertilizers, exclusive of freight, was: Kainit, $11 per ton; S. C. Dissolved Bone, $13.50 per ton The cost per acre as applied in this experiment was $7.10. The increased yield caused by the use of the fertilizers was at the rate of one hundred and sixty-one and one-third bu. per acre, which at 40 cts. per bu., amounts to the sum of $64.53⅓, leaving a net profit of $57 43⅓ per acre, less the increased labor required to take care of the increased crop.

III. The Comparative Yield of Large and Small Potatoes, by planting the tubers Whole, in Halves, Quarters, and cut to one eye in each piece.

Table C. shows very clearly the results of cutting the potatoes before planting. It will be observed that in making this test, the ground for each variety on each plat was divided into four equal parts, one-fourth being assigned to Whole potatoes, one-fourth to Halves, one-fourth to Quarters, and one fourth to pieces containing but a single eye, and to each part was assigned the same number of pounds of seed potatoes, except the first fourth of the White Star variety. This Table should be studied in connection with Table D, which shows the number and vigor of stalks produced in each hill. By an examination of this table we find that in the Early Rose variety, that the whole potatoes, on plats Nos. 7, 9 and 10 produced more than the halves, and Nos. 1 and 2 produced more than the quarters, and No. 1 produced more than the three eyes (three

pieces, one eye each, to the hill,) while in all other cases the halves, quarters and single eyes produced decidedly more than the whole potatoes. Taking the whole ten plats of the Early Rose together, we find that the average yield of large potatoes are as follows: Whole, 18.50; Halves, 21.10; Quarters, 19.90; Three Eyes, 24.25; showing that the same amount of seed, planted on the same amount of ground, the whole potatoes produced the smallest amount, while those cut to a single eye in the piece, produced the largest amount, or a little more than 30 per cent. more than the whole potatoe. When we examine the table in regard to the White Star variety, taking into consideration the fact that the amount of seed was doubled (planted 18 inches apart instead of 3 feet) in the second and third rows of the whole potatoes, the results are still more remarkable, showing the decided advantage of cutting the potatoe. To show the ratio of increased production by an increase of the seed, I increased the seed in the second and third rows 100 per cent., yet the average increase in production is less than 50 per cent.

The table in the case of the Beauty of Hebron, seems to favor the planting of the whole potatoe, but it is believed that under the same conditions, the same results would appear as in the Early Rose and White Star. Along the upper side of the lot where the Beauty of Hebron was planted, there is an old stony fence row, which could not be properly plowed, and therefore the potatoes planted in it were under very great disadvantage, and failed to make the growth and production they otherwise would.

TABLE C.

Number of Plat.	Fertilizers. Kainit.	Fertilizers. Nitrate of Soda.	Fertilizers. S. C. Diss. Bone.	EARLY ROSE. Whole. Large.	EARLY ROSE. Whole. Small.	EARLY ROSE. Halves. Large.	EARLY ROSE. Halves. Small.	EARLY ROSE. Quarters. Large.	EARLY ROSE. Quarters. Small.	EARLY ROSE. Three Eyes. Large.	EARLY ROSE. Three Eyes. Small.	WHITE STAR. Whole. Large.	WHITE STAR. Whole. Small.	WHITE STAR. Halves. Large.	WHITE STAR. Halves. Small.	WHITE STAR. Quarters. Large	WHITE STAR. Quarters. Small.	WHITE STAR. Three Eyes. Large	WHITE STAR. Three Eyes. Small.
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs	Lbs.
1	42.00		...	21.50	6.00	28.00	4.50	17.75	5.25	20.75	6.50	30.75	3.75	21.50	5.75	19.00	4.50	32.75	5.70
2	42.00	8.33	......	21.50	1.50	24.50	2.50	15.00	3.00	25.00	5.00	44.12	2.00	31.50	4.25	28.00	2.00	42.50	3.75
3	42.00	....	21.00	26.75	4.50	35.00	3.75	28.25	5.25	30.00	7.00	53.67	1.75	53.25	3.75	43.00	3.50	42.25	4.00
4	42.00	8.33	21.00	22.00	1.25	30.25	3.00	27.25	4.25	28.25	7.00	42.75	3.50	42.25	2.50	39.50	3.75	46.00	4.50
5		......	....	11.00	1.00	14.75	2.50	15.25	4.00	24.50	3.67	19.00	2.00	18.25	3.75	18.50	2.75	24.50	4.25
6	21.50	......	....	9.00	3.75	11.00	2.50	11.75	3.25	20.50	3.25	32.75	1.50	32.75	2.50	35.75	2.50	39.00	3.25
7	21.[illegible]	8.33	...	11.50	3.75	13.50	3.00	15.25	3.50	21.50	3.25	26.50	2.50	18.50	1.50	23.00	2.75	33.75	3.00
8	21.50	...	21.00	21.00	2.75	23.50	2.75	31.75	6.00	29.50	6.50	45.75	3.25	31.50	3.12	32.25	3.25	48.25	4.75
9	21.50	8.33	21.00	23.00	2.00	19.50	4.00	20.75	4.50	26.00	4.50	43.50	3.25	43.25	4.00	42.75	3.25	62.00	4.50
10	21.00	....	......	15.25	3.50	11.00	2.00	16.00	4.25	16.50	3.75	23.50	4.00	21.75	3.50	14.50	3.00	21.25	5.50

TABLE C.—Continued.

Number of Plat.	BEAUTY OF HEBRON.								WHITE STAR—Whole Potatoes Planted One in Each Hill.												Increased Yield by Doubling the Number of Hills in the Row.		Percentage of Increase.
	Whole.		Halves.		Quarters.		Three Eyes.		First Row Planted 3 ft. Apart.						Second Row Planted 18 in. Apart.								
	Large.	Small.	Large.	Small.	Large.	Small.	Large.	Small.	Large.		Small.		Total.		Large.		Small.		Total.				
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Oz.	Lbs.	Oz.	Lbs.	Oz.	Lbs.	Oz.	Lbs.	Oz.	Lbs.	Oz.	Lbs.	Oz.	
1	23.50	5.50	16.00	4.50	17.50	5.75	12.50	3.50	7	12.00	1	2.50	8	14.50	11	7.75	1	5.75	12	13.50	3	15.00	44.15
2	28.50	3.75	21.00	5.75	10.50	4.25	8.00	3.00	12	11.25	......	8.00	13	4.50	15	11.50	......	11.50	16	7.00	3	2.50	23.79
3	35.00	4.00	45.25	6.25	41.50	4.50	24.00	2.75	13	7.00	....	10.00	14	1.00	20	1.50	....	9.50	20	11.00	6	10.00	45.30
4	35.50	4.50	31.25	5.25	26.75	5.25	22.00	3.00	11	9.00	1	12.00	13	5.00	15	10.50	....	13.50	16	8.00	3	3.00	23.19
5	23.00	4.75	15.75	3.50	12.25	3.50	6.75	5.00	6	.50	......	10.50	6	11.00	6	8.00		11.75	7	4.75	....	9.75	9.09
6	30.75	3.75	22.25	3.75	21.25	3.50	13.75	4.50	8	......	.....	4.00	8	4.00	12	6.00	....	10.00	13	.....	4	12.00	57.57
7	22.25	3.00	20.00	4.50	13.50	3.75	11.75	3.50	7	6.00	1	....	8	6.00	9	9.00	....	12.00	10	4.00	1	14.00	22.38
8	34.00	4.75	34.00	5.50	38.75	5.75	16.25	3.75	11	....	1	4.00	12	4.00	17	6.00	1	....	18	6.00	6	2.00	56.00
9	45.25	4.50	43.75	5.25	30.00	4.00	14.75	5.00	12	....	1	....	13	....	15	12.00	1	2.00	16	14.00	3	14.00	29.73
10	18.50	5.50	19.00	4.75	28.00	4.50	13.75	5.00	6	2.00	1	5.00	7	7.00	8	12.00	1	5.00	10	1.00	3	10.00	35.29

IV. The number and vigor of the Stalks produced by tubers planted whole, and cut into halves, quarters, and single eyes.

By an inspection of Table D., we find that in all varieties, the whole potatoe produces a greaters number and more vigorous stalks, than either the halves, quarters or single eyes, and that the general rule is a gradual diminution of the number and vigor of the stalks, as the size of the pieces planted diminishes, until we reach these cut to one eye in each piece, when we find that the number of the stalks is very materially increased. Estimating the average number of eyes in each whole potatoe, at 16, we find in the whole potatoe of the Early Rose and Beauty of Hebron, abont one-third, or 33 per cent of the eyes germinate; in the White Star about one-fourth, or 25 per cent. Of the halves of the Early Rose and Beauty of Hebron, about 40 per cent., and of the White Star, about 30 per cent. Of the quarters of the Early Rose and Beauty of Hebron, about 60 per cent., and of the White Star, about 50 per cent. Of those cut to single eyes, nearly all germinated. We further find that the increased yield is not in proportion to the increase of the number of stalks. From these facts we infer that in the preparation and planting of the seed to secure the best results, the potatoe should be so cut as to secure one strong vigorous stalk from each piece, and plant so as to secure from three to four stalks to each hill.

The facts set forth in this bulletin are not intended to establish any fixed rules for growing potatoes. They are only intended to show the actual results of the experiment as conducted at this Station, on very inferior soil. Upon other soils and under other conditions the results may be very different ; yet it is insisted that the facts herein set forth, are worthy of very careful consideration, and will very materially assist the farmer in preparing his seed for planting, and in selecting the fertilizers necessary to produce the best results.

TABLE D.

Number of Plat.	EARLY ROSE. Whole. Average No. of stalks to each hill.		Halves. Average No. of stalks to each hill.		Quarters. Average No. of stalks to each hill.		3 Eyes. Average No. of stalks to each hill.		WHITE STAR. Whole. Average No. of stalks to each hill.		Halves. Average No. of stalks to each hill.		Quarters. Average No. of stalks to each hill.		3 Eyes. Average No. of stalks to each hill.		BEAUTY OF HEBRON. Whole. Average No. of stalks to each hill.		Halves Average No. of stalks to each hill.		Quarters. Average No. of stalks to each hill.		3 Eyes. Average No. of stalks to each hill.	
		Average highth of stalks, in inches.		Average highth of stalks, in inches.		Average highth of stalks in inches.		Average highth of stalks, in inches.		Average highth of stalks, in inches.		Average highth of stalks, in inches.		Average highth of stalks, in inches.		Average highth of stalks, in inches.		Average highth of stalks, in inches.		Average highth of stalks, in inches.		Average highth of stalks, in inches.		Average highth of stalks, in inches.
1	5.40	18.40	3.44	17.70	2.50	14.87	4.33	16.11	4.00	25.00	2.88	19.88	1.87	16.63	3.90	16.56	5.66	23.33	1.00	18.55	2.91	17.15	3.00	13.91
2	5.00	19.50	3.20	17.00	2.39	13.33	3.38	15.10	3.55	22.41	2.75	18.25	2.41	15.53	3.07	18.64	6.60	20.00	3.88	17.11	3.14	15.14	3.00	10.45
3	9.20	20.80	4.00	20.00	3.07	18.93	3.79	17.58	2.72	23.18	3.08	23.83	2.91	20.41	1.80	18.60	6.80	23.60	5.50	22.00	3.00	22.30	3.31	16.00
4	6.00	22.00	4.11	20.00	2.47	19.23	3.17	17.33	2.50	22.10	2.79	21.27	2.30	17.70	3.21	19.78	5.50	24.33	3.50	18.91	3.77	20.22	4.40	20.00
5	5.00	18.33	3.80	14.80	2.23	14.69	3.58	15.28	2.87	18.25	2.30	16.90	2.12	17.00	2.84	15.54	5.00	17.33	4.00	16.11	3.25	11.50	2.69	13.61
6	4.40	18.60	3.35	14.77	2.46	15.53	3.33	14.35	3.39	18.50	1.20	18.60	2.27	17.50	2.66	18.20	5.66	21.16	4.27	19.27	2.36	15.15	3.45	15.18
7	4.66	19.00	3.91	16.18	2.76	16.64	3.23	14.8[illegible]	5.50	19.33	3.00	15.77	2.92	16.08	3.71	16.00	7.20	22.40	3.50	16.87	2.85	15.71	2.82	15.63
8	5.60	20.40	3.87	17.75	3.66	18.60	4.06	17.37	3.83	21.83	2.51	20.00	2.50	17.43	2.85	17.07	5.80	21.40	3.87	20.25	2.84	19.66	3.08	17.08
9	4.40	21.20	2.88	17.66	3.00	15.81	3.66	19.27	1.80	21.40	2.58	19.91	1.71	22.58	3.07	21.93	8.60	22.40	4.75	22.25	3.33	18.66	3.30	15.80
10	5.20	20.40	3.50	17.10	2.42	15.94	3.06	15.8[illegible]	1.14	20.83	2.50	17.08	1.60	17.13	3.85	17.42	6.33	19.50	5.70	18.00	3.77	18.00	3.33	19.55

TOMATOES.

TEST OF VARIETIES.

The following experiment was conducted for the purpose of testing the comparative merits of some of the leading varieties of tomatoes. The seed was sown in an ordinary hot-bed, aboue the 15th day of April, and transplanated to their permanent location about the 20th day of May. The soil in which they were cultivated, was "broken-up" on the 25th and 26th days of March. The soil is a grayish-yellow clay, with no vegetable mould, and had been completely improverished by long cultivation. The tomatoe plants were set in hills three and one-fourth feet apart, in rows five feet apart. The hills were prepared by digging holes seven inches deep and eighteen inches wide, in each of which was put one peck of stable manure, (horse dung). This was thorougly mixed with the clay, by digging down the walls of the hole, leaving the surface of the hill, level with the surface of the ground. After the usual delay caused by transplanting, the plants made a vigorous growth, and by the 25th day of June, all varieties, except the Mikado, were blooming. On the 3rd day of July, the Brandywine had attained a heighth of 22 inches, with fruit from one to two inches in diameter, and plenty of bloom. Early Market Champion had attained a heighth of 20 inches; witn less fruit and bloom than the Brandywine; largest fruit about one inch in diameter. Ignotum had attained a heighth of 20 inches; fruit and bloom a little less plentiful than on Brandywine; largest fruit about one and one half inches in diameter. Cumberland Red, plants 16 inches high, good set of fruit; largest fruit two inches in diameter. Atlantic Prize, plants 16 inches high, fruit more abundant than on any other variety; largest fruit about two inches in diameter. Mikado, or Turner's Hybrid, 20 inches high, very virgorous growth, no fruit, and very few flowers.

While the plants were yet erect, stakes were driven about eight inches from each plant, to which the plants were tied with common wool twine, to prevent them from falling to the ground. None of the plants were pruned in any manner. They were cultivated thoroughly, with a horse-cultivator and common hoe, and permitted to grow in the natural way, supported by the stakes as already described. The plants were vigorous and stalky, branching very profusely, and of a dark green color. The earliest fruit ripened about the 3rd day of August, and the first picking occurred on the 5th. The general ripening of all varieties, except Mikado, did not begin until about the 14th day of August, the first general picking occuring on the 17th.

Table E., shows the time of ripening and the amount gathered for each day from the 5th day of August to the 3rd day of October, inclusive. It is somewhat difficult to determine which is the earliest of the four varieties—Brandywine, Early Market Champion, Ignotum and Atlantic Prize. Taking the first three periods of pro-

duction as shown by Table F., and adding to the first period the amount gathered on the 5h, 6th and 7th of August, we have the number of pounds produced by each plant of each variety for the period named, as follows :

	Brandywine.	Early Market Champion.	Ignotum.	Atlantic Prize.	Cumberland. Red.
Aug. 5 to 17	0.54	0.40	0.64	0.70	0.31
Aug. 18 to 24	0.96	1.18	0.52	....	0.10
Aug. 25 to 31	2.06	2 06	2.75	1 93	3.08
Total	3.56	3.54	3.91	2.63	3.49

For these different periods, we find that in their productiveness, these several varieties rank in the order named, as follows :

First period : Atlantic Prize, Ignotum, Brandywine, Early Market Champion, Cumberland Red.

Second period : Early Market Champion, Brandywine, Ignotum, Cumberland Red, Atlantic Prize.

Third period : Cumberland Red, Ignotum, Brandywine, Early Market Champion, Atlantic Prize.

By reference to Table E., it will be seen that for continuous bearing and productiveness, these varieties have the preference in the order named, as follows : Ignotum, Brandywine, Cumberland Red, Early Market Champion, Atlantic Prize, Mikado or Turner's Hybrid. The Altantic Prize is a very peculiar tomato in several respects. The plant does not grow large, being much smaller than any of the other varieties named. It has a peculiar habit of "setting" its fruit very abundantly, all at the same time, the plant presenting almost a solid mass of tomatoes from the root to the top. It grows and ripens this setting of fruit, but produces no more. Another serious objection to this tomato is its strong tendency to burst its skin in ripening, leaving its surface thoroughly scarified, and rendering it liably to premature decay during wet weather.

The Mikado, or Turner's Hybrid is a very vigorous grower, the plants being much larger than any of the other varieties tested, but it is nearly three weeks later in setting and ripening its fruit, and ceases bearing about two weeks earlier than the others. Besides, the fruit had a strong tendence to premature decay throughout the season.

The Ignotum, Brandywine, Cumberland Red and Early Market Champion, are worthy of very high commendation, especially the first three named. Their fruit is large and smooth, of a beautiful deep red color, flesh quite solid, good keepers, and specially adapted for market gardens, where shipping qualities are essential.

During the early part of the ripening season of all of these varieties, there is a tendency, of greater or less extent, to premature decay of the fruit. To determine the extent of this tendency, all fruit of this character ripening during the month of August, was separately weighed and the percentage of fruit of each variety

affected by premature decay was ascertained to be as follows: Brandywine, 10.63 per cent. Early Market Champion, 21.87 per-ct., Ignotum, 18.12 per ct., Cumberland Red, 5.27 per ct, Atlantic Prize, 24.92 per ct., Mikado, or Turner's Hybrid, 20.00 per ct. The quantity of the fruit of the first four varieties affected by premature decay during the month of September, was very small while the fruit of Atlantic Prize and Mikado continued to suffer from premature decay throughout the season. At the time of gathering the last ripe fruit from the Mikado and Atlantic Prize, on the 21st and 22nd days of September, there was no green fruit on the plants; while on the 3rd day of October, there was an abundance of green fruit on the Brandywine, and a considerable quantity on the Cumberland Red, Ignotum and Early Market Champion, all of which was destroyed by frost. Taking into consideration all of the characteristics of these varieties of tomatoes, I would classify them, in their order of merit, as follows: Brandywine, Ignotum, Cumberland Red, Early Market Champion, Atlantic Prize, Mikado, or Turner's Hybrid.

TABLE E.

Showing the Date of Ripening and the Yield of Different Varieties of Tomatoes.

DATE OF RIPENING AND GATHERING.	Brandywine.		Early Market Champion.		Ignotum.		Cumberland Red.		Atlantic Prize.		Mikado or Turner's Hybrid.	
1891.	Lbs.	Oz.	Lbs.	Oz.	Lbs.	Oz.	Lbs.	Oz.	Lbs.	Oz.	Lbs.	Oz.
August 5	3		4	11								
6			2				2		8	5		
7	3		1	12	1	7			5	7		
17	35	8	22		35		17		45		12	8
18	26	4	42		30		6	8				
22	46	8	48		41							
25	31		17				23	12	23	6		
27	25	8	75	1	100	5	107					
28									17	8		
29									121	8		
31	90	8	64	8	57	8	57	8			111	
September 1	18								65			
3			41	4	33							
4					31				30			
7	104		25						123		185	
8					58	12						
9							109	12				
10	18	8	37	8			29	8	41			
11	33		10									
12					32							
14	51		32		41		58		30		225	
15	34						9	8				
16	57	12	30		49	8	32	4	24		55	
19	72						15		66		10	8
21	43	8	88		94	12	16	8			35	
22					19		56		21	8		
26					10							
28	101	4	49									
29					13		21					
October 1	5		15		42	8						
2	27	12										
3			7		14	4	35	8				
Whole number of pounds	836	8	611	13	707		596	12	623	10	636	8
Number of Plants	76		76		57		61		84		105	
No. of Pounds to each Plant	11.00		8.05		12.40		9.78		7.42		6.06	

TABLE F.

Showing the Yield for Each Week, during the Bearing Season, and the Average Yield per day, of Each Variety.

PERIOD OF PRODUCTION.	Number of Days.	Brandywine.		Early Market Champion.		Ignotum.		Cumberland Red.		Atlantic Prize.		Mikado, or Turner's Hybrid.	
		Number of Pounds.	Average Number of Pounds per Day.	Number of Pounds	Average Number of Pounds per Day.	Number of Pounds	Average Number of Pounds per Day.	Number of Pounds.	Average Number of Pounds per Day.	Number of Pounds.	Average Number of Pounds per Day.	Number of Pounds.	Average Number of Pounds per Day.
August 8 to 17	10	35.50	3.50	22.00	2.20	35.00	3.50	17.00	1.70	45.00	4.50	12.50	1.25
August 18 to 24	7	72.75	9.11	90.00	12.85	30.00	4.28	6.50	.81	....	....	....	....
August 25 to 31	7	157.00	22.42	156.56	22.28	157.81	22.40	188.25	26.89	162.37	23.19	114.00	16.23
September 1 to 7	7	122.00	17.43	66.25	9.43	64.00	9.14	....	....	219.00	31.28	185.00	26.43
September 8 to 14	7	102.50	14.66	79.50	11.35	131.75	18.82	197.25	28.18	71.00	10.14	225.00	32.14
September 15 to 21	7	207.25	28.60	118.00	16.85	144.25	20.60	73.25	10.46	90.00	12.85	100.50	14.36
September 22 to 28	7	101.25	14.46	49.00	7.00	29.00	4.14	56.50	8.07	21.50	3.07	....	....
September 29 to October 3	5	32.75	6.55	22.00	4.40	69.75	13.95	35.50	7.07	....	....	....	....

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WEST VIRGINIA
Agricultural Experiment Station,

MORGANTOWN, W. VA.

INJURIOUS INSECTS
AND
PLANT DISEASES.

APRIL, 1892.

CHARLESTON, W. VA.
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METHODS OF DEALING

With Injurious Insects and Plant Diseases.

A. D. HOPKINS, *Entomologist.*

C. F. MILLSPAUGH, *Botanist.*

The object of this Bulletin is to place in the hands of those in West Virginia who have to contend with injurious insects and plant diseases, a compilation of general methods recommended by the best authorities in this country—official entomolgists, botanists, successful farmers, and gardners.

We have drawn freely from Experiment Station Bulletins, Government and State Reports, and special works and papers treatiug upon these subjects; selecting those methods and formulae which have been submitted to successive tests and practical application and found to be reliable, and such others which, our judgement and experience lead us to belive, are worthy of adoption.

The fact that the conditions under which farmers conduct their business are so varied (each necessarily adopting methods peculiarly suited to his locality or circumstances) make it difficult if not impossible for us to recommend a single remedy or method of application that would yield satisfactory results to all. A method requiring expensive apparatus might yield great profit to a large grower who has hundreds of acres to operate upon, while the same method would be utterly out of the question for the small grower who would find the apparatus alone to cost more than the value of the resulting crop. On the other hand a simple inexpensive method which would double the small growers' profits, would not be practicable for the large grower, on account of the extra time and labor necessary in applying the measure. We deem it best therefore to give in this connection a general outline of methods, formulae. and instructions, from which each may select for adoption those suited to his individual needs.

In this age of close competition and low prices the farmers who are making money are those who are quick to adopt methods which their better judgment tells them will yield a profit or at least prevent loss. That there is profit in a properly conducted warfare against injurious insects and plant diseases, when the conditions justify the means, there is no longer a doubt. A loss of hundreds

of thousands of dollars is sustained each year by the producers of this State from these causes alone, much of which could be prevented to those who study to adopt methods best suited to the peculiar requirements in each case.

In dealing with the enemies mentioned, as in all other profitable enterprises or methods, there are certain principles relating to the subject that the operator must become familiar with before he can reasonably expect to gain the highest results from the practice. It is therefore just as necessary for those who adopt the less expensive and complete apparatus to have this rudimentary knowledge, as it is for those who are compelled to utilize every known method on a large and expensive scale.

In this bulletin we shall give the fundamental principles underlying the practice of applying methods to the prevention and killing off of these pests, trusting that those who may desire particular information, before we publish more advanced proceedures, will freely correspond with us as their interests may demand.

We are engaged in this Station to devote our entire time to investigations and research for the benefit of the farmers of the State, and the advencement of economic agriculture. We are testing methods, machinery, formulae, etc., in order to determine and adapt the best to our own State needs, and ask you as farmers and readers of this and other of our publications to criticise, question, and suggest, as well as to try carefully any methods we may publish that suit your crops and necessities, and report your success or failures giving your reasons for such in as far as you deem them contributive to the results gained, this will aid us in future work and publications of all of which you will receive the primary benefits.

INJURIOUS INSECTS.

Among the elementary requirements necessary to the intelligent application of the methods mentioned under this head, we will only discuss a few of the most important.

Insects and Some of Their Peculiar Habits.

The word insect is derived from two Latin words, meaning cut in two, or divided into sections. The class of creatures to which this name is applied is very different from all other kinds of animal life.

The life of all insects begins with an embryo contained in an egg; resembling in this respect some other kinds of animals, yet they differ from all others in the first active form emerging from the egg, and the subsequent changes which take place before their lives are complete. The first form is usually entirely different both in appearance and habits from the parent which deposited the egg, and it is in this first active stage of their lives that they do their growing and principal feeding. At this stage they are familiarly known as caterpillars, grubs and maggots, properly as larva, (plural larvæ). After a time, varying from a few days to 17 years, according to the species, they change into another form different from the first. In this second stage, certain kinds remain inactive without food until the perfect form developes within the shell, from which they emerge in due time to deposit eggs for another generation. This inactive form is called pupa, (plural pupæ).

Caterpillars develop into moths, ("millers") and butterflies; grubs into beetles; maggots into bees, flies, etc.; all of which go through what is termed a complete transformation.

Those going through an incomplete transformation, are grasshoppers, squash bugs, plant lice, etc., which are active in all their forms, from the time they leave the egg until they have attained wings. The larvæ and pupæ of this class of insects bear a general resemblance to the parent form; but they never have wings, while the perfect forms nearly always do.

How Insects Feed.

Injurious insects are divided into two broad divisions, or classes according to their manner of feeding.

1st. Biting or chewing insects include all of those in the perfect or imperfect forms, which bite and consume the substance upon which they feed.

2nd. Sucking or piercing insects, include all of those perfect or imperfect forms which pierce their food substance with a beak, and suck out the sap, juice, or blood from beneath the surface.

Therefore, if a strange insect makes its appearance threatening the destruction of some plant or crop, before selecting a method to repel or destroy it, it is first necessary to ascertain how it feeds. If it belongs to the first division, and like the potato beetle, eat the leaves, it may be easily destroyed by Paris green applied to its food substance, either in a powder or liquid, as the poison will be eaten by them with their food.

On the other hand, if, like squash bugs, plant lice, and other insects belonging to the second division, they suck the sap from the plant causing it to wither and die; poison will have no effect on them, because we can not apply it to the inside of the plant where they get their food. Most of this class of insects may, however, be easily destroyed with remedies like insect powder, kerosene, emulsion etc., which kills by contact when it is applied to the insects themselves.

Preventive Measures.

By preventives is meant any method which will repel or prevent the attack of insects. "An ounce of 'Preventive' is even better than a pound of cure" in dealing with insects, for we find that often we may not only prevent injury by them, but we may gain large benefits to the crops and our farms, as will be seen from some of the following methods:

High Culture and Fertilization is probably one of the best preventives of insect attack, for it is a well known fact that most insects have a preference for weak or unhealthy plants on which to feed and deposit their eggs; while this is not the universal rule (as insects are known to attack perfectly healthy plants and trees), yet this fact is evident. Perfectly healthy plants, if they do not entirely resist attack, may at least recover from it, while weakened and sickly ones invite attack, and are most sure to succumb.

Fertilizers. My experience has been that coarse stable manure, at the rate of fifteen or twenty loads to the acre applied to sod in winter, and plowed under for corn in early Spring, will prevent the attack of White Grubs and Wire Worms, even in badly infested fields.

Wood Ashes, leached or unleached, have been successful with me in preventing the attack of Peach and Apple Tree borers, if applied in a conical heap about the base of the trees in May of each year.

Soap placed in the forks of trees, or suds applied to the trunks is recommended to repel borers of various kinds from depositing eggs. (Formula 10.)

Commercial Fertilizers. Kainit, and brands containing a large per cent. of Potash, are recommended as remedies or preventives against insect attack

Nitrogen in the form of Nitrate of Soda is also recommended for the same purpose.

Tobacco, a valuable fertilizer, is used against the cucumber beetle, cabbage maggot, etc., to prevent their feeding and depositing eggs. The stems and wastes are used for this purpose.

That it is profitable to apply most of the fertilizers mentioned for their fertilizing qualities alone is evident, and when we consider the added benefit in protection against destructive insects, it seems that every one should realize the importance of such methods, and we hope that farmers generally will try some one or all of them, and report to us their success or failure, especially with stable manure and commercial fertilizers.

Rotation of Crops. If a crop is grown for a number of successive years in the same field, the insects injurious to it are liable to increase to the greater detriment of the crop each year; a system of rotation will avoid this to a great extent. We would mention the following rotation as a suggestion, as each must judge to a certain extent for himself.

Meadow 2 years; corn, with fertilizer, 1 year; potatoes, with fertilizer, 1 year; wheat and fertilizer the next, then back to meadow. This would require 5 years to elapse between the time any one crop would occupy the same field.

General Farm Management with a view of preventing insect depredations and attack, such as time of plowing and sowing; selection of plants less liable to attack; clean farming, burning or converting into manure all trash and rubbish; cutting and burning all dead branches and infested trees and plants; using the ashes to prevent further attack; feeding fallen fruit to hogs, sheep and poultry, or roting them in the compost heap.

Many other methods will suggest themselves to the thoughtful and observing farmer, that will help him to make his business profitable in more ways than that of preventing insect attack alone.

Preventing Egg Deposits. Dr. Lintner, State Entomologist of New York, advances the theory that insects are attracted to plants "not by the sense of sight, but by that of smell, and that substances giving off a strong odor like lamp oil, coal tar, carbolic acid, gas lime, and the remedies applied to or near the plants to be protected, prevent egg deposit by giving out an odor overpowering that of the plant or animal itself, thereby preventing its recognition by the insect." If this theory is correct, the importance of the measure is evident, for as Dr. Lintner argues, "if no eggs are deposited, we have no artificially concealed eggs to seek for; no larvæ whose rapacity and destructiveness we must arrest; no pupæ whose retreat is to be discovered and no perfect forms to be captured or entrapped."

Fencing Out includes any method which will keep insects away by placing a barrier between them and any plant or fruit to be protected. Among these: are covering plants or small shrubs with thin muslin or mosquito bar; bagging choice fruit in paper bags; paper and metal bands to protect young plants from cut worms; and tar paper bands for peach and apple tree borers.

With all the preventive measures mentioned, it would seem that we should have no use for remedies. Perhaps we would not if every one were thoroughly acquainted with all insects, their habits, and methods of dealing with each; and would be persistent in the thorough and prompt application of such knowledge. It is safe to say, however, that such a condition will never exist; and that after all, certain kinds of insects will appear, which will destroy certain crops, if they are not killed by the prompt application of poisons and other substances, which we will mention under the head of remedies.

Beneficial Animals.

Many of the domestic and wild animals of the farm are efficient aids in the destruction of injurious insects, and may be made even more useful than they are, by a little knowledge and careful management on the part of the farmer.

Sheep are useful in orchards to feed on fallen fruit and destroy the insects contained in them.

Hogs are valuable to root for and destroy grubs in meadows just prior to plowing for some cultivated crop. They may also be utilized, either in the orchard or the pen, in consuming fallen fruit.

Poultry. Turkeys subsist principally on grasshoppers when they can get them, and may be bread to a good advantage where this insect is plenty, not only as a destroyer of the insects, but as a profitable product of the farm.

Chickens confined in a plum orchard are said to be very beneficial in feeding on the Plum Curculio, thus protecting the fruit. Coops of small chickens in gardens to feed on flea beetles, etc., is also recommended.

Ducks are recommended to free gardens of certain kinds of insects, especially potato beetles.

Birds. The protection of certain kinds, and the destruction of the English Sparrow is especially recommended by many writers.

The *skunk* is undoubtedly the friend of the farmer in feeding on grubs and mice, and should be protected.

Toads consume immense quantities of insects and their domestication has been recommended for gardens.

Remedies.

Remedies proper differ from preventives (which are sometimes called remedies) in the fact that preventive measures are used to avert an attack, and remedies are used after the attack is made.

The six best remedies in general use are: Paris Green, London Purple, Kerosene Emulsion, Pyrethrum (insect powder), White Hellebore, and tobacco in various forms.

Killing with Poisons.

Paris Green is a combination of arsenic and copper. It came into general use as a destroyer of the Colorado Potato Beetle directly after that insect made its appearance. It is probably one of the most widely known insecticides and more generally used than any other. It will kill most of the biting insects provided it is pure, and is applied in the proper proportion and at the right time. There are some insects like the Rose beetle, on which it seems to have no effect in the strength safe to apply to the foliage of plants.

Injury to Foliage. If used too strong it will burn or kill the leaves, certain kinds being affected more than others, and strange to say, it may be used stronger on young foliage than on that older or matured.

Diluents. It may be diluted either with dry or liquid substances, and should be usually diluted just enough to not injure the foliage.

Dry Mixtures. In its dry state it may be used all the way from pure, or mixed with one hundred parts of a diluting substance, depending on the plants on which it is to be used. It may be diluted with a cheap quality of wheat flour, which is probably the best substance for this purpose on account of its adhering to the plants and being more readily eaten than other substances. Plaster, finely sifted ashes, air-slacked lime, road dust, etc., may also be used as diluents. Much care in all cases should be taken to thoroughly mix the poison with the diluent that it may be evenly distributed.

Application of the Powder. The simplest and best method of application to small plants and shrubs is to tie a muslin bag containing the powder to the end of a stick or pole and dust it over the plants.

It is usually claimed that powder substances should be applied in the morning when the plants are wet with dew; while this may have its advantages, it is not always necessary, as it may in most cases be applied at any time in the day, but never when the wind is blowing hard; a very gentle breeze is claimed to be a help in distributing the powder to the under side of the leaves. In all cases the operator should keep on the windward side to avoid breathing the powder.

Wet Mixtures. In most cases the liquid application has advantages over the dry, especially when used on a large scale, and to fruit trees. Dilute with water at the rate of one pound of the powder to 40 or even 350 gallons of water, according to the kind of plants on which it is to be applied. On a small scale, a teaspoon to a tablespoonful is sufficient for four or five gallons of water. Flour paste added to the water is claimed to be a decided benefit.

Application of the Liquid. The simplest method is a broom or brush by which the liquid is sprinkled or thrown on the plant, this

method is well adapted to application on a small scale. The ordinary watering pot provided with a finely perforated rose is often sufficient for kitchen and flower gardens. For large shrubs, fruit trees and field crops, pumps and spraying apparatus must be secured for doing thorough and efficient work. (See Spraying machinery.) It is not the strength of the mixture but the force and thoroughness with which it is applied that secures success, hence pumps and nozzles should be selected, which are best suited to these requirements.

London Purple is a refuse material obtained in the manufacture of analine dyes, and its principal constituents are arsenic acid, and lime. It is cheaper and better in most cases than Paris Green, except that it is more liable to injure the foliage. However, when diluted with hard water, or the addition of lime, it is said to prevent this injury; hence it is admirably suited to mix with the bordeaux mixture, (see formula 19), as a combined remedy for insects and plant diseases, otherwise the remarks on diluting, applying, etc., of the former remedy will apply as well to this.

Caution in Using Paris Green and London Purple.

There is no danger in properly using these poisonous substances if the following rules are observed:

The poison should be kept in a safe place, and plainly labeled POISON.

Do not distribute the poison with the hands.

Always keep to the windward side of plants or trees when applying the powder or liquid.

Do not use them upon leaves or fruits which are soon to be eaten. There is seldom, if ever, any danger in eating vegetables and fruit after they have been exposed to the sun and rain for a few weeks, as several pounds or bushels of treated fruits or vegetables would have to be consumed at one time by one individual to get a sufficient dose of the poison to produce serious results.

Test the strength of the diluted mixture on a few plants first to ascertain if it will injure the leaves.

Never apply it to fruit trees while in bloom, as the poison will kill the bees so necessary to the formation of perfect fruit.

Killing by Contact.

Kerosene Emulsion. A mixture of lamp oil, soap and water, (see formula 3), is probably the best known remedy for plant lice, lice and ticks on animals, the Horn Fly, and many other sucking insects.

Application. It may be applied on a small scale to house plants, etc., with perfume atomizers; to garden vegetables with garden syringe; and to large trees and field crops with the more expensive machinery.

Insect Powder, (Pyrethrum), is manufactured from a plant which is grown largely in California for the purpose. It is very extensively

used to kill house flies, mosquitoes, cabbage worms and many other insects. It kills by stopping up the breathing pores, and is only hurtful to insects. It may be applied as a powder or diluted with water. As a powder, it may be diluted with flour and applied on a small scale with a small tin bellows, or on a larger scale with Woodason's bellows or Leggett's Powder Gun.

White Hellebore is a vegetable substance which will kill certain insects both by poisoning and by contact, and is used successfully against Currant Worms, Rose and Cherry Slugs. Its principal value, however, is that of destroying Currant Worms. This, like insect Powder, may be used dry or in water. This should be labeled Poison.

Tobacco Dust is manufactured from tobacco stems and other refuse, large quantities of which may be found at cigar factories, packing houses, etc., which may usually be had for the asking. This material may be used without grinding into powder, and is valuable both as an insecticide and as a fertilizer, if liberally used around plants and trees. A strong tea made from it will kill plant lice and other insects. It is also used to destroy lice on cattle, ticks on sheep, and to drive away cucumber beetles, etc.

Miscellaneous Remedies.

Hand-Picking must often be resorted to as a remedy for certain kinds of insects, such as tobacco, tomato and other large "worms," and the eggs, cocoons and perfect forms of certain kinds which it is not practicable to destroy otherwise.

Jarring Method, by which insects are jarred or shaken from the plants and caught in sheets, then burned or crushed, is sometimes the best means of dealing with certain insects which will fall from the plants when disturbed.

Beating the insects from low plants into a pan of water, soapsuds or oil, is sometimes the most practical method for dealing with the potato bug, rose bug, etc.

Cutting Out grubs from the apple and peach, after they have once entered the bark, is probably the surest way of ridding the trees from such pests. They may also be killed by probing for them with a small wire.

Ditching. To collect marching caterpillars, etc., like the army worm and chinch bug.

Hot Water is often used to kill insects, such as ants, cabbage worms, rose bugs, etc.

Road Dust or clay dust is recommended as an efficient remedy for slugs, especially cherry slugs, as it adheres to their slimy bodies, causing them to die.

Vapors. Grain, pea and bean weevels may be easily destroyed by the vapors of bisulphide of carbon, if the grain or seeds are placed in a tight bin, and a small quantity of the liquid poured on, then covered with blankets, the vapors being heavier than air will settle through the mass and kill the weevels contained therein. This

is a dangerous poison to man and very imflammable. Use excessive care in handling.

Coal Tar is used largely in the West for the destruction of grasshoppers. It is placed in a long shallow tin or sheet iron pan and pulled over the ground, the grasshoppers jump in and are destroyed.

For the successful application of the remedies and methods mentioned the following rules should be observed:

1st. Observe and study the habits of insects, that you may attack them at their weak points.

2nd. Ascertain how insects feed before applying a remedy.

3rd. Endeavor to prevent attack by high farming and fertilization.

4th. If a remedy must be resorted to, do not delay, but apply it while the insects are young, or when they first make their appearance.

5th. Select that remedy which will yield the best results at the least expense, but do not hesitate to use expensive methods if they will pay in the end.

6th. Apply all liquid and powder remedies as thorough as possible. If a poison, the under as well as the upper surface of every leaf should be reached. If a contact remedy, every insect should be saturated or covered with it.

7th. If further information is desired on any subject relating to insects, questions in writing should be sent to the Experiment Station, and they will be answered either by letter, in county papers, or in future bulletins.

8th. Always send specimens with letter of inquiry if possible. Send live insects in tin or wooden boxes with some of their food substance, (air holes are not necessary in such packages). Send dead insects in quills, small envelopes, homœpathic vials, etc., packed in cotton, or tin boxes. Such packages sent by mail will cost 1 cent per ounce.

Sections of infested trees or plants, and large packages should be sent by express.

9th. Any information sent to the Station regarding the appearance and destructiveness of injurious insects in any locality of the State, and reports of success or failure with remedies for insects will be thankfully received. Prompt attention will be given to inquiries, and due credit for information if published.

DISEASES OF PLANTS.

The first principle to impress upon the minds of those who desire to give some attention to the diseases of plants and the best method of combating them, is the fact that these diseases are of themselves plants, which, instead of living in the soil, find their proper place of growth mostly to be upon plants of higher organization than themselves. They reproduce by seed much as any plant does, but have the power of producing a far greater abundance than their more fully developed hosts.

Among these plants are the great numbers of rusts, smuts, moulds, rots, mildews, knots, spots, bunts, blights, ergots, scabs, cracks, yellows, etc., that are becoming such deplorable reducers of profit in agriculture and horticulture.

These peculiar forms of life are all thrown together, by their general similarity, in one large class called Fungi, which includes every like plant from the Toadstool down to the microscopical germs found present in putrefying animal and vegetable matter; the aftermath of death.

Fungi (plural of Fungus) are of very simple organization and differ from other plants in many ways, principally, however, first: In the absence of green coloring matter (chlorophyll) so noticeable in the higher order of plants, a principle which they are compelled to draw from those already possessing it; second: the absence of flowers, they producing their seed (spores) directly from their stems or branches; third: having no chlorophyll they do not need the influence of the sun so materially in their growth. Fungi are therefore plants of darkness, dampness, destruction, and disease, all of which are necessary to their subsistence; it is for this reason that crops are affected in proportion to the murkiness of the season, and

all such other conditions as tend to vitiate their strength. Fungi that thrive upon living plants are called *parasitic*, and are always detrimental to man; those which live upon dead plants *saprophytic*, many of which are beneficial, and some even edible and nutritious.

Why is it that for fifty years or more our crops and plants in general have become more and more infested by these diseases, may probably be explained by the fact that a greater profusion of spores are annually produced by natural increase; and that lands are becoming in too many instances too poor to produce vigorous crops from a lack of careful and proper fertilization on the part of the farmer.

The spores of parasitic fungi are so exceedingly minute that they are able to penetrate directly through the microscopic pores of the plants upon which they fall, making their way into the internal tissues of the leaf or stem from which they sap the vital juices. On this account the leaf or stem once attacked can not be saved, nor can the fungus so secluded be dislodged or killed by poisoned applications. Treatment, therefore, of plant diseases must be divided into three heads: Exclusive, Hygienic, and Tropical.

Exclusive Treatment.

During winter, the spores of parasitic fungi weather much as the seeds of higher plants do, life remaining dormant within their coatings. They catch in crevices of bark, on dead leaves, seeds or withered fruits, or rest upon the ground beneath or about the plants upon which they fructified the previous season, ready to spring into life as soon as a warm and moist spring or summer day incites them.

This being the fact then, we must first attempt each season to exclude these living germs from new crops of their special hosts; this we may do by exerting the followiug precautions:

1. Never plant grain upon a field that showed rusts, bunts, or ergot the previous season, until the land has rested in sod or has been cropped for several seasons with widely different plants from those previously grown thereon.

2 Never sow seed grain procured from a locality where bunts, smuts, or ergot are suspected to have existed, without first treating the seed as directed under Formula 11. This treatment is always recommended to be used as a safeguard even when no doubt has crept in concerning the cleanliness of the seed.

3. Carefully cut out all Barberry and Blackberry briers from the neighborhood of your wheat fields.

4. Cut out and burn all old Plum and Cherry trees dead with the Black Knot. Prune off all formed and young knots and burn them. Clear off all Wild Cherry and Plum trees from about your home and orchard.

5. Rake off and compost with plaster, or burn, all dead leaves from your vineyards and orchards, replacing them with good clean manure or well rotted compost.

6. Carefully reject all tubers (potatoes, etc.,) when cutting for seed that show the least sign of disease of any kind.

7. In procuring young trees or sions for planting, look to it that they come from a region not known to be infested by diseases.

8. Barnyard manure especially that containg much stable bedding, is often a fertile method of spreading disease, therefore, carefully compost such manure with a liberal supplv of plaster and see to yet that it is well-rotted before spreading. If the straw used as bedding is known to be rusty, then keep such separate from the general heap and use it only on root crops or orchards.

The above points intelligently and carefully followed will tend to substantially decrease plant diseases upon your farm.

Hygienic Treatment.

It is a well known truism in medical science that contagious diseases seldom if ever attach a healthy, cleanly, strong and well-nourished person; and *per contra*, that a person illy-nourished, poorly fed and clad, uncleanly in habit, overworked either mentally or physically, or who has not followed the general rules of physical hygiene; is particularly open to "catch" almost any infections disease that at the time may be going about. If this is true of animal life, why should it not also be of vegetable? We feel confident in stating that it is; therefore, to avoid diseases of crops as fully as possible the farmer or horticulturist should see that his plants are properly fed (fertilized); well clad (drained or dressed); well ventilated (cultivated and cleared of weeds); strong (pruned and suckered); and otherwise treated in a proper plant-hygienic manner.

This with proper exclusive treatment as detailed above, should reduce diseases of crops to a minimum.

Topical Treatment.

Should however the two above treatments be omitted, or be considered insufficient for any reason, then we must resort to the applicetion of some substance that will prevent the spores of disease from germinating upon the plants. I have appended a list of the more prominent diseases which should be treated with the formulæ mentioned under them. These formulæ will be found at the end of this Bulletin, and the proper apparatus used for their application will also be found under the head of Spraying Apparatus. All the apparatus there described are excellent, their principal difference lies in the amount of work each will do at one loading. You will of course select that one that will best suit your purse and purpose, according to the amount of territory you need to cover, and the time you have to devote to such operations.

The proper time to spray for each disease is given below in connection with it. The general method is one that tends to completeness; that is to say, the use of a hose and nozzle that will throw a very fine spray and will be so controllable that this spray may

be directed in all directions and thus reach all surfaces of the plant to be sprayed. Should a rain fall occur shortly after spraying the benefits of that application will be lost, and should be repeated as soon as possible.

Checking. Should you desire to prove to yourself, what you gain by the use of any application or operation, leave a certain row or patch untreated as a check upon the method, that by comparing in the field or orchard, the crop of the treated with that of the untreated, you may be able to say positively whether the time and outlay have paid or not when harvest comes.

Plant Diseases and Treatment.

Grape Mildew, and Black-rot: The fruit once infected by the disease cannot be saved. Spray the vines with formula 12 before the leaf buds have opened; again with formula 16 just before the flowers open; again with formula 17 when the berries are about the size of peas; and about two weeks before harvesting the fruit.

Grape Bitter-rot: The same treatment will suffice to prevent this disease unless very prevalent, when formula 13 should be used for the first treatment.

In these diseases of the vine, if you should desire to use a powder, having a bellows, instead of a liquid, having no spraying apparatus; then formula 18 may be used with as good results. Should the vines be troubled with any insects that are eating the leaves then add one-fourth pound Paris green to the formula before using.

Black Knot of the Plum and Cherry. Prune out, after the leaves have fallen, all branches affected with old knots and burn them. Cut out young knots thoroughly, and apply lamp-black and linseed oil to the wounds so made. Spray thoroughly before the leaves appear in spring with formula 12; and after the flowers have fallen with formula 19, this will prevent the leaf rust also, as well as protect the fruits from the curculio.

Apple Scab. Spray first just after the flowers have fallen (before the fruit pip turns downward,) with formula 19, which will also defend the fruit against the codling moth. Subsequent sprayings (at least three or more) may be made with formula 15 or 17, but no Paris green nor London purple whatever should be mixed with these.

Pear and Quince Leaf Blight. Spray with formula 17, as directed for grape mildew.

Pear Fire-Blight and Peach Yellows. So far as known these diseases are very contagious and incurable. Should any trees become affected by these diseases dig them up and burn them as soon as possible to save the balance of your orchard from infection.

Potato Blight and Rot and Tomato Rot. Spray seed potatoes in the hills before covering, with formula 14 or 15. Then spray tops with formula 19 every two weeks, making from three to five applications in all. In case you desire to use a powder instead, then formula 18 should be used. If bugs are eating the vines add one-fourth pound of Paris green to the formula before applying.

Should you desire particular advice for any special disease, we would be glad to answer your request for the same by mail at any time, especially if you will send a specimen of the disease in or with your letter of inquiry.

FORMULAS.

For Insects.

No. 1. Paris green or London purple, (liquid).
a. Poison powder, 1 pound.
Hard water, 200 gallons.
Cost about 1 cent for 10 gallons.
b. Poison powder, 1 pound.
Flour paste, 5 pounds, or liquid glue, 1 pint.
Hard water, 150 to 300 gallons.
Cost from 1 to 2 cents per 10 gallons.
c. Poison powder, 1 to 3 teaspoonfuls.
Hard water, 4 gallons.
Cost about one-half cent.

Directions. Moisten the powder and work into a paste with a paddle, then add it to the whole amount of water and stir frequently when in use.

For codling moth and curculios on apple, plum and cherry, use formula *a* and apply as soon as the blossoms fall from the trees and again in ten or fifteen days.

For peach trees the weakest solution must be used.

No. 2. Paris green or London purple (dry powder).
a. Poison powder, 1 pound.
Wheat flour, 10 pounds.
Road dust, plaster or coal ashes, 20 pounds.
Cost about 1½ cents per pound.
b. Poison powder, one teaspoonful.
Flour, lime or coal ashes, 40 to 100 teaspoonfuls.
Cost about 1 cent.

Directions: Sift the lime or coal ashes, add the flour and poison and mix very thoroughly. Apply with bag, bellows, or powder gun.

No 3. Kerosene Emulsion, (A. J. Cook.)
Soft soap, 1 quart.
Water, 2 quarts.
Lamp oil, 1 pint.
When diluted, cost about 1½ cents per gallon.
Directions: Boil the soap in the water, remove from the fire, and

when boiling hot add the oil, then violently stir or churn until the mixture forms a thick cream.

For plant lice, cattle lice and young caterpillars, dilute six pints of the emulsion with seven pints of water and apply thoroughly with brush, atomizer or sprayer.

Kerosene Emulsion (C. V. Riley.)

Hard soap, ½ pound.

Water, 1 gallon.

Lamp oil, 2 gallons.

When diluted costs about 1½ cents per gallon.

Directions: Boil the soap in the water until all is dissolved, remove from the fire and add the oil, then churn for ten minutes or spray it back into the vessel until it is thoroughly mixed and will form a substance like butter when cold. Dilute with 9 parts of water 1 of the emulsion, and apply as in the Cook formula.

No. 4. Potash Soap.

Concentrated lye, 1 pound.

Cotton seed oil, 3 pints.

Soft water, 3 gallons.

Costs when diluted, 15 cents per 100 gallons.

Boil the lye in water until dissolved, then add the oil and boil for two hours, replacing evaporated water with hot water from time to time. Use 1 pound of this soap to 8 or 10 gallons of water on lice-infested plants and trees, and wash the trunks and branches with a stiff brush. This remedy has been highly recommended for this purpose.

No. 5. Fish Oil Soap.

Concentrated lye, 1 pound.

Fish oil, 3 pints.

Soft water, 3 quarts.

When diluted, costs about 35 cents per 100 gallons.

Directions: Same as No. 4. This is a valuable remedy for plant lice, etc.

No. 6. Pyrethrum Powder.

a. Pure powder, 1 part.
Flour 10 to 20 parts.

Directions. Mix thoroughly, place in a tight vessel and allow to stand for a few hours, then apply with a bellows. This is recommended for Cabbage Worms.

Pyrethrum liquid:

b. Powder, 1 tablespoonful.

Water, 2 gallons.

Directions. Stir the powder into boiling water and use as soon as cool enough.

No. 7. White Helebore. (Liquid).

Powder, 1 tablespoonful.

Water, 1 gallon.

Directions. Dissolve in the water and apply with sprayer or brush. The dry powder is used without diluting. The liquid or powder is the best known remedy for the currant and gooseberry worms, rose slugs, etc.

No. 8. Tobacco Decoction.

Tobacco stems or dust, 1 pound.

Water, 3 gallons.

Directions. Boil until the strength is extracted from the tobacco, then strain and boil the liquid down to one pint. For use, dilute one part of the liquid with eight parts of water. This is a remedy highly recommended for plant lice, flea beetles and many other insects.

Tobacco dust, if finely ground, will kill most smooth bodied caterpiliars, plant lice, etc., if thoroughly applied to them with the bellows or powder gun. It is also excellent to drive away the Horn Fly if thoroughly rubbed in among the hair on cows and other cattle.

No. 9. Kerosene Ointment.

Lard, 1 pound.

Sulphur powder, 1 ounce.

Lamp oil, ¼ pint

Directions. Mix the lard and sulphur, then add the oil. This is valuable for killing lice on poultry and domestic animals, also used on the horns of cattle to drive away the Horn Fly.

No. 10. Carbolic Acid Soap.

Soft soap, 1 quart.
Or hard soap, 1 pound.

Water, 2 gallons.

Carbolic acid, 1 pint.

Directions. Add the soap to the water and boil until it is dissolved, then add the acid. This is used as a wash for trees to prevent insect attack, and for lice on animals. Apply with a scrub brush.

For Plant Diseases.

No. 11. Hot water.

Water heated to 135 to 140 Fahrenheit.

Directions. Place seed grain suspected of being smutty, in a coarse sack and plunge the whole in a barrel of this hot water. Be sure that the water is no hotter than 140, and no cooler than 135; or in the first instance you would kill the seed, and in the second you would not destroy the disease spores. Swash about the loose grain in the plunged sack for eight or ten minutes, then remove, spread, and dry quickly; Then sow as soon as possible, in ground that you know is not smutted.

No. 12. Simple solution of copper sulphate.
Copper sulphate (blue-stone, blue-vitriol,) 1 pound.
Soft water, 22 gallons.
Cost three-sixteenths of a cent per gallon.
Directions. Dissolve the copper sulphate in the water. This solution will keep any length of time.

No. 13. Simple solution of iron sulphate.
Iron sulphate (copperas) 5 pounds.
Soft water (hot) 22 gallons.
Cost one-half cent per gallon.
Directions. Dissolve the iron sulphate in the hot water, and use as soon as possible thereafter.

No. 14. Bordeaux mixture.
Copper sulphate (blue-stone, blue-vitriol), 4 pounds.
Unslaked lime, 4 pounds.
Water, 22 gallons.
Cost ⅓ cent per gallon.
Directions. In a wooden, glass, or eathen vessel, dissolve the copper sulphate in sixteen gallons of the water. In another vessel slake the lime in six gallons of the water. Strain the lime through a sieve and stir it into the copper sulphate solution. It is now ready for use. Never make this mixtute in any other way than this.

No. 15. Eau Celeste, modified.
Copper sulphate (blue-stone, blue-vitriol) 2 pounds.
Soda carbonate, (washing soda) 2½ pounds.
Ammonia (22 Baume), 1½ pounds.
Water, 22 gallons.
Costs 1⅓ cents per gal.
Directions: Dissolve the sulphate of copper in the vessel described as under Formula 14, in two gallons of boiling water. In another vessel dissolve the soda in two gallons of water. Add the soda solution to the copper solution, and when settled add the ammonia. Now add enough water to make 22 gallons of the mixture, and use as soon as possible.

No. 16. Burgundy Mixture, Modified.
Copper sulphate (Bluestone, Blue-vitriol.) 2½ pounds.
Soda carbonate (Washing soda) 3¼ pounds.
Hard soap (shaved), ½ pound.
Water, 22 gallons.
Cost 1½ cents per gallon.
Directions: In a vessel as mentioned under formula 14, dissolve the copper sulphate in twelve gallons of water. In another vessel dissolve the soda in ten gallons of water. Strain the soda solution through a seive, and stir it into the copper solution. Dissolve the soap shavings in one-half gallon of boiling water, and stir it into the mixture. Use as soon as possible.

No. 17. Ammoniacal Carbonate of Copper.
Copper carbonate, 3 ounces.
Ammonia carbonate, 1 pound.
Water, 50 gallons.
Cost 1 1/3 cents per gallon.
Directions: Dissolve the two carbonates in a half gallon of hot water. Dilute this solution to fifty gallons.

No. 18. Copper and Sulphur Powder.
Sulphate of copper (very dry and finely powdered), 1 pound.
Flowers of sulphur, 10 pounds.
Air slaked lime, 1 pound.
Cost 4 1/3 cents per pound.
Directions: Mix thoroughly, and use in a bellows or powder gun.

No. 19. Bordeaux Mixture, with Paris Green, or London Purple.
Copper sulphate (Bluestone, blue-vitriol), 2 pounds.
Unslacked lime, 4 pounds.
Water, 22 gallons.
Paris green or London purple, 2 ounces.
Cost, 1/2 cent per gallon.
Directions. Mix as stated under formula 14, then add the Paris green and stir in well.

SPRAYING APPARATUS.

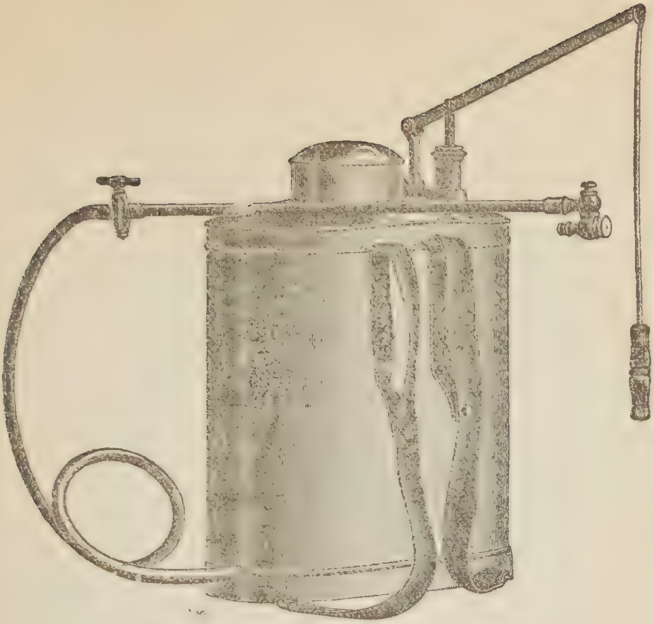
The implements illustrated here are all good ones, but not all that are upon the market. We would suggest that those intending to use insecticides and fungicides write to any reliable dealer for catalogus of such aparatus; and choose that which will best suit the amount of work to be done. The points to be insisted upon are: That all working parts coming in contact with the liquid should be made of brass, and have an arrangement for keeping the liquid agitated in its receptacle while the spraying is going on; and that the spray shall be as fine and constant as possible.

We place the illustrations in the order of the quantity each will handle, and the price, without special regard to their merits.

Fig. 1.

Woodason Atomizer.

Fig. 1 represents the "Woodason Atomizer," which is recommended as a very useful implement, especially for indoor and small plats, where but little area is to be covered at any one operation.



THE EXCELSIOR KNAPSACK SPRAYER. FIG. 2.

Fig. 2 represents one of the forms of Knapsack Sprayers, all of which are meritorious and cost in the neighborhood of $14. They carry about 8 gallons at a charge, and are capable of covering considerable territory.

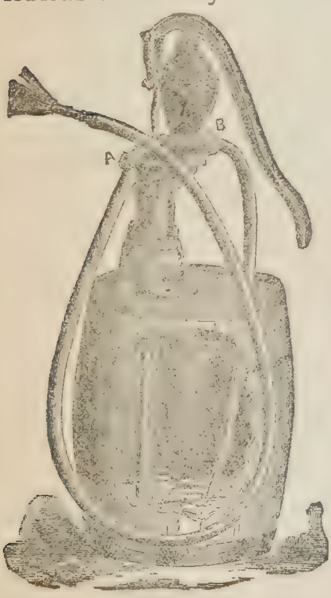


FIG. 3.

Fig. 3 calls attention to one of the larger machines. This "Perfection Spraying Outfit" is an excellent type of its class, costing without barrel, $10 in iron, or about $12 in brass, which should be selected.

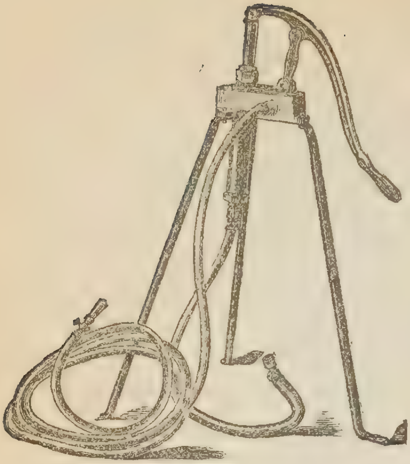


Fig. 4.
NEW STYLE CLIMAX TRIPOD PUMP.

Fig. 4. Represents the "New Style Climax Tripod Pump," which will cost (including the nozzles represented in Fig. 5.), from $15 to $20 according to size. When mounted with a barrel upon a wagon or sled, this outfit will prove very efficient for covering large areas of crops, or orchards of considerable acreage,

These cuts illustrate the nozzles. No. 3 shows the outer end covered by a wire screen, which cuts the water into spray. No. 2 shows nipple end of same. No. 1 shows the nozzle entire.

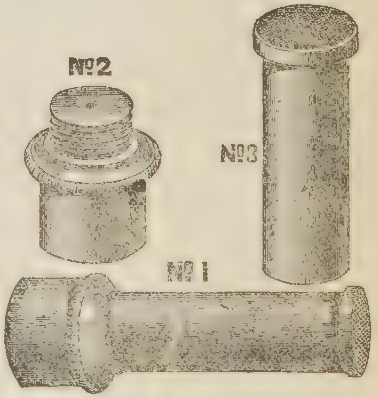


Fig. 5.

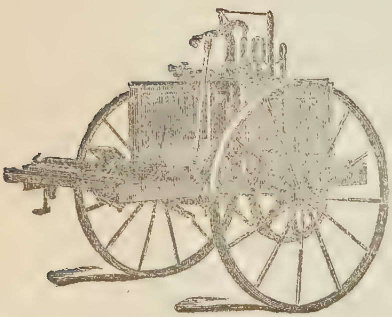


Fig. 6. Shows an improved Field and Orchard machine for extended operations. This machine costs, with gearing, $85.

POWDER APPARATUS.

FIG. 7.—WOODASON DOUBLE CONE BELLOWS.

Figure 7 is a cheap form of bellows, well adapted to the application of powder on a small scale. Price, $3.

FIG. 8.

Figures 8 (and 9 upon another page) represent the cheapest form of "Leggett's Powder Gun," an implement admirably adapted to the application of dry powders to field crops and fruit trees. There is also a larger form manufactured by this company, called "Leggett's Paris Green and London Purple Gun," at $12.

Manufacturers.

Implements figures 1 and 7, are manufactured by Thomas Woodason, 451 E. Cambria St., Philadelphia.

The Knapsack figure 2, is made by William Stahl, of Quincy, Illinois.

The Perfection Spraying Outfit figure 3, and several others of this type, are from the works of the Field Force Pump Co., Lockport, N. Y.

Implements 4, 5 and 6, are manufactured by The Nixon Nozzle & Machine Co., Dayton, Ohio.

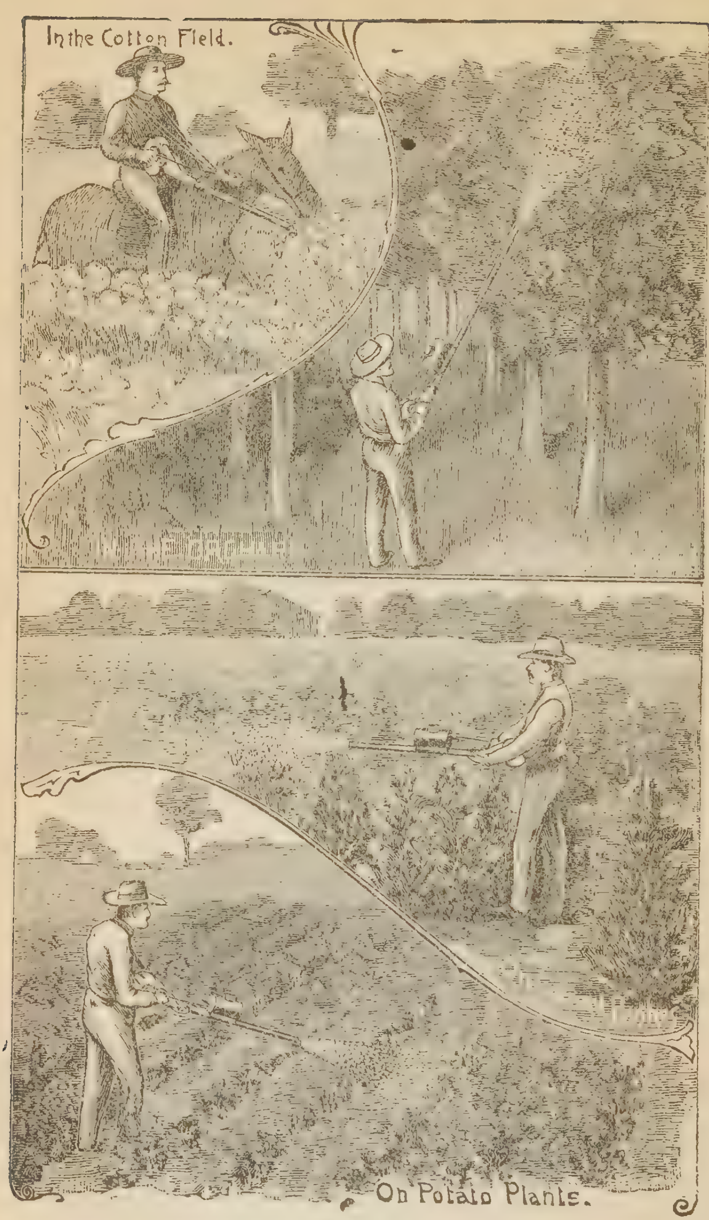


Fig. 9.
Leggett's Dry Powder Gun.

The Dry Powder Gun, Figs. 8 and 9, is manufactured by Leggett & Bros , 301 Pearl St., New York.

All of these firms manufacture many different kinds of apparatus which are fully described in their free catalogues.

There are several other reliable firms advertising in the leading agricultural papers who will send out full descriptions of the implements they have for sale, upon application. Most of the leading seedsmen also either manufacture or act as agents for spraying apparatus, and keep for sale insecticides and fungicides as well.

We would caution all to use good judgment in the purchase of the chemicals, and to look with considerable doubt upon all insecticides advertised as "cure-alls;" these, like many patent medicines, are often more profitable to the manufacturer than to the user.

A spraying outfit, which will cost from \$3 to \$15, and the small bellows and powder gun, costing from \$2 to \$5, together with the cheap formulæ mentioned in this bulletin, will usually prove amply sufficient for the West Virginia farmer and fruit grower; and if used intelligently will pay a large per cent. on the investment.

VOLUME II. NUMBER 10.

Bulletin No. 22

WEST VIRGINIA

Agricultural Experiment Station

MORGANTOWN, W. VA.

YOUR WEEDS AND YOUR NEIGHBOR'S.

Part 2.

DISTRIBUTION OF OUR WEEDS.

BAD POINTS OF WEEDS.

WEEDS AS FODDER FOR STOCK.

CHEMICAL WEED EXTERMINATORS.

FEBRUARY, 1892.

CHARLESTON:
MOSES W. DONNALLY, PUBLIC PRINTER.
1892.

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YOUR WEEDS AND YOUR NEIGHBOR'S.

C. F. MILLSPAUGH, M. D.

My idea in issuing Bulletin No. 12 on the Canada Thistle, in December, 1890, was not only to call attention to that most pestilential and obnoxious weed, and to stimulate the farmers of this State to a deeper interest in the weeds of their neighborhood; but also to gain their co-operation in determining the extent of such growths in the State, as well as their ideas of the best methods of procedure in relation to weeds, special and general. How far I have succeeded these bulletins will show. Suffice it to say, however, that I feel justified in remarking that I do not think any Station in the Union ever gained so many willing and painstaking answers to any set of questions, or have awakened so much interest among their farming communities as we have in this. Hearty co-operation has been unstintedly gained, and all requests for sample weeds promptly and kindly granted. For all of this, I wish to heartily and publicly express the thanks of this Station, and hope that my efforts to tabulate these answers will result in placing all this material before you in a satisfactory and easily understood form.

This bulletin contains a digest of the material received arranged by sections and counties, in order that the weeds should be more or less grouped according to their alliance to each other, as to character of soil, nature, altitude and geographic position. In studying this method of grouping, it must be borne in mind, that I have in most part used only the matter received from my correspondents; that their observations are generally confined to their limited neighborhoods; that their ideas differ according to their methods of farming and the crops and stock they raise; and that many years of constant and personal travel and observation only could solve the many problems offered by the weed and filth question.

This artificial grouping is as follows:

(1) Valley Counties: *i. e.* Such as lie in the eastern Pan Handle of the State and on the eastern slopes and foot hills of the Alleghany Mountains, comprising the fertile valleys of the Potomac, Cacapon, Opequon and Shenandoah Rivers, and the ridges and slopes of the North and South Fork, Patterson's Creek, Big Piney,

Jersey, North River, and Great North Mountains, viz: Jefferson, Berkeley, Morgan, Hampshire, Hardy, Mineral, Grant and Pendleton.

(2) The North-eastern Mountain Counties: *i. e.* such as lie in or near the north-eastern stretches of the higher Alleghanies, the Rich, Laurel, Cheat, Shavers, East and Dry Fork Mountains; and the valleys of the Forks of Cheat and Tygart's Valley Rivers, viz: Tucker and Randolph.

(3) The Eastern Mountain Counties: *i. e.* Those that lie on or near the higher Eastern Alleghany ranges and Lower Rich and Cheat, as well as Elm, Buffalo Bull, Buffalo Lick, Beaver Lick, Cranberry, Big Clear Creek, Elk, Peeter's and Pott's Mountains, and the valley of the Greenbrier River, viz: Webster, Pocahontas, Greenbrier, Summers and Monroe.

(4) The Northern Counties: *i. e.* Such as lie along the northern or Pennsylvania boundary line, and Lower Cheat and Monongahela Rivers, viz: Preston, Monongalia, Marion and Taylor.

(5) The Northwestern Ohio River Counties, comprising such as lie in the upper Pan Handle of the State and on the banks and terraces of the Ohio River, as far South as the mouth of the Little Kanawha, viz: Hancock, Brooke, Ohio, Marshall, Wetzel, Tyler, Pleasants and Wood.

(6) The Western Ohio River Counties: Comprising the balance of such as lie along the Ohio, and the mouths of the Great Kanawha, Guyandotte and Big Sandy Rivers, viz: Jackson, Mason, Cabell and Wayne.

(7) The North Central Counties: Comprising all the central counties lying more or less north of the Great Elk River, and constituting the principal water shed of the Little Kanawha and Monongahela, viz: Barbour, Harrison, Doddridge, Upshur, Lewis, Ritchie, Wirt, Roane and Braxton.

(8) The South Central Counties: Comprising those lying south of the Great Elk River and north of the Guyandotte and Spruce Fork Mountains, through which flow the New, Gauley, Elk, Big Coal and Great Kanawha Rivers, viz: Putnam, Kanawha, Clay, Nicholas, Fayette, Lincoln, Boone and Raleigh.

(9) The Southern Boundary Counties: *i. e.* Those drained by the Guyandotte and Big Sandy Rivers, viz: Logan, Wyoming, McDowell, Mercer.

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144.	T: Stalling,	Medley,	Grant.
145.	Thos. Alderson,	Johnson's Cross R'ds	Monroe.
146.	H. C. Hyer,	Lloydsville,	Braxton.
147.	George Parker,	Clio,	Roane.
148.	S. W. Wiles,	Amblersburg,	Preston.
149.	G. W. Gander,	Clio,	Roane.
150	Silas C. Hatcher,	Egeria,	Raleigh.
151.	S. A. McCarty,	Lobelia,	Pocahontas.
152.	J. P. Thompson,	Williamsburg,	Greenbrier.
153.	George C Whiting,	Summit Point,	Jefferson.
154.	Henderson Gross,	Gazil,	Kanawha.
155.	Sibert Speek,	Hedgesville,	Berkeley.
156.	H. W. Frye,	Wardensville,	Hardy.
157.	James Binns,,	Independence,	Preston.
158.	J. C. Mann,	Pickaway,	Monroe.
159.	C. W. Morris,	Reedy,	Roane.
160.	G. W. Williams,	Trout Valley,	Greenbrier.
161.	C. S. Jones,	Piedmont,	Mineral.
162.	A. F. Cochran,	New Martinsville,	Wetzel.
163.	F. F. Randolph,	New Milton,	Doddridge.
164.	S. C. Gist,	Wellsburg,	Brooke.
165.	John L. Babb,	Greenland,	Grant.
166.	James W. Benner,	Leetown,	Jefferson.
168.	Jacob McLean,	Belington,	Barbour.
169.	Fremont McClure,	Squire Jim,	McDowell.
170.	Gen. John McCausland,	Grimm's Landing,	Mason.
171.	Dice Bennett,	Dillon's Run,	Hampshire.
172.	J. L. Knight,	Maggie,	Mason.
173.	L. D. Anderson,	Walkersville,	Lewis.
174.	Chas. W. Morris,	Tornado,	Kanawha.
175.	George E. Moray,	Rock Gap,	Morgan.
176.	C. W. Coyle,	Charlestown,	Jefferson.
177.	C. W. Henshaw,	Middleway,	Jefferson.
178.	Jefferson Stephens,	Adkin's Mills,	Wayne.
179.	John Price,	Proctor,	Wetzel.

	Names.	Place.	County.
180.	W. D. Zinn,	Phillippi,	Barbour.
181.	G. W. Annon,	Thornton,	Taylor.
182.	John W. Hawkins,	Centre Point,	Doddridge.
183.	Wm. H. T. Lewis,	Kabletown,	Jefferson.
184.	B. W. Knode,	Rippon,	Jefferson.
185.	E. J. Owings,	Holiday's Cove,	Hancock.
186.	Booth Bond,	Aberdeen,	Lewis.
187.	John Menear,	Independence,	Preston.
188.	John L. Roderick,	Mount Storm,	Grant.
189.	W. H. Woodull,	Beaver Mills,	Nicholas.
190.	David Simmons,	Walnut Grove,	Roane.
191.	Joseph Hill,	Gazil,	Kanawha.
192.	S. H. Secrist,	Maysville,	Grant.
193.	J. C. Miller,	Wellsburg,	Brooke.
194.	J. W. Miller,	Barboursville,	Cabell.
195.	W. S Goodwin,	Texas,	Tucker.
196.	S. N. Smith,	Rockville,	Preston.
197.	Col. McKinney,	Hebron,	Pleasants.
198.	James Wilmoth,	Kerens,	Randolph.
199.	Alex. Clohan,	Martinsburg,	Berkeley.
200.	E. L. Nuzum,	Garfield,	Jackson.
201.	A. F. Slaughter,	Belgrove,	Jackson.
202.	A. J. House,	Reedy,	Roane.
203.	A. D. Hopkins,	Kanawha Station,	Wood.
204.	D. D. Johnson,	Long Reach,	Tyler.
205.	C. L. Jones,	Mannington,	Marion.
206.	John Bacher,	Deer Walk	Wood.
207.	James W. Lake,	Kanawha Head,	Upshur.
208.	J. A Evans,	Raleigh C. H.,	Raleigh.
209.	B. D. Gangwer,	Parkersburg,	Wood.
210.	A. & R. McLeod,	White Sul. Springs,	Greenbrier.
211.	John Ferguson,	Schultz,	Pleasants.
212.	M. Byrnside,	Carpenters,	Putnam.
213.	Austin J. Hatcher,	Egeria,	Raleigh.
214.	Marshal A. Johnson,	Johnson's Cross R'ds	Monroe.
215.	L. Owens,	Odaville,	Jackson.
216.	S. D. Stump,	Higginsville,	Hampshire.
217.	William H. Smith,	Hazleton,	Preston.
218.	Chas. L. Davis,	Fort Spring,	Greenbrier.
219.	Henry Keadle,	Pickaway,	Monroe.
220.	William L. Knotts,	Grafton,	Taylor.
221.	D. S. Hartman,	Confidence,	Putnam.
222.	H. P. Collett,	Hendricks,	Tucker.
223.	George White,	White Sul. Springs,	Greenbrier.
224.	M. Morris,	Silverton,	Jackson.
225.	M. W. Morrison,	Peniel,	Roane.
226.	B. F. Maloney,	Sedan,	Hampshire.
227.	R. N. Fout,	Purgitsville,	Hampshire.

Name.	Place.	County.
228. T. H. Morris,	Rockport,	Wood.
229. Geo. A. Alexander,	Milton,	Cabell.
230. A. E. Black,	Lee,	Wirt.
231. Geo. W. Wells,	Cornwallis,	Ritchie.
232. J. T. Harvey,	Blaine,	Mineral.
233	Springfield,	Hamphsire.
234. Ben F. Sivert,	Glen Easton,	Marshall.
235. A. T. Heck,	Barracksville,	Marion.
236. V. B. Frame,	Frametown,	Braxton.
237. J. H. Teagarden,	Blake,	Wetzel.
238. Jacob Weaver,	French Creek,	Upshur.
239. Jno. W. Sions,	Old Fields,	Hardy.
240. Eben Langfitt,	Fairview,	Hancock.
241. C. B. Shreve, Jr.,	Overhill,	Upshur.
242. A. A. Welton,	Petersburg,	Grant.
243. Isaac Knotts,	Grafton,	Taylor.
244. J. H. Mandeville,	Indian Mills,	Summers.
245. John S. Barnes,	Ritchie C. H.,	Ritchie.
246. Edwin Hollister,	Welch Glade,	Webster.
248. E. W. Barnes,	Countsville,	Roane.
249. J. E. Clarke,	Hemlock,	Upshur.
250. A. O. Donovan,	Fowler's P. O.,	Brooke.
251. N. D. McLain,	Blandville,	Doddridge.
252. John Stout,	Wallace,	Harrison.
253. Lewis M. Pritchard,	Walnut Grove,	Roane.
254. P. E. Reed,	Valley Fork,	Clay.
255. L. D. Hambric,	Tate Creek,	Braxton.
256. C. S. Hatcher,	Kentuck,	Jackson.
257. G. M. Nettles,	Elmira,	Braxton.
258. Charles E. Davis,	Rockport,	Wood.
259. Amos Jones,	Gray's Flat,	Marion.
260. John M. Gribble,	Leopold,	Doddridge.
261. M. L. Knight,	Meadland,	Taylor.
262. W. Guseman,	Henry,	Preston.
263. D. S. Minear,	St. Georges,	Tucker.
264. Patrick Haman,	New Hope,	Mercer.
265. C. R. Hanaman,	Elizabeth,	Wirt.
266. T. S. Colter,	Newville,	Braxton.
267. Strother Hatten,	Egypt,	Wayne.
268. Dr. J. J. Hopkins,	Upper Tract,	Pendleton.
269. Eli Crouch,	Crickard,	Randolph.
270.	Princeton,	Mercer.
271. Frank Ralphsnider,	Gray's Flat,	Marion.
272. H. W. Schell,	Greenland,	Grant.
273. J. D. Rardon,	Ravenswood,	Jackson.
274. George A. Porterfield,	Charlestown,	Jefferson.
275. F. M. Horner,	Dayton,	Harrison.
276. Robert Davis,	Basnett,	Marion.

Name.	Place.	County.
277. G. W. Putnall,	Williamstown,	Wood.
278. Camden Trimble,	Pepper,	Barbour.
279. Jas. A. Thomas,	Flat Run,	Marion.
280. John A. Chew,	Charlestown,	Jefferson.
281. J. W. Bogges,	Lumberport,	Harrison.
282. T. C. Hammet,	Schultz,	Pleasants.
283. Joseph McMurran,	Shepherdstown,	Jefferson.
284. Obed Babb,	Greenland,	Grant.

DISTRIBUTION OF OUR WEEDS.

The first question propounded in Bulletin No. 12, was: "What are the worst weeds in your neighborhood? Please write them in the order of their obnoxiousness beginning with the worst."

This question was answered by 284 observers, whose observations with my own, are compiled in the following summaries of the tables at the end of this bulletin; which will present many points of interest to those who desire to study them.

The numbers in the column headed "Observer," refer back to the same numerals set against the names in the list of observers on pages 179-85, which gives the locality in the county as well. The numerals set opposite the observer's number in the tables refer to the order in which he considers the weeds bad, *i. e*, observer **183**, who is found to reside near Kabletown, in Jefferson, judges the Blue Thistle to merit the first rank as a bad weed in his neighborhood; that Dog Fennel ranks second; that the Ox-eye Daisy ranks third; and so on throughout his list.

The small figures following the names of the weeds and raised above the line refer in all cases in this work to the same numbers in the Descriptive List of Weeds forming Part 3 of this bulletin, where the weeds are treated of specifically and more at length.

Valley Counties.—Table 1*.

It will be seen that in the Valley Counties, the Blue Thistle is reported from each; that it is more frequently considered a bad weed than any other plant mentioned; and that it is given standing as the worst weed by 18 out of 38 reporters.

Note the fact that the Glenn Weed[15] and Water Cress[11] run out after passing through Jefferson and Berkeley Counties, they not being again reported. The Naked Weed[112] runs out in Hampshire. The Ox-eye Daisy[99] though mentioned in all counties of the table is more particularly considered in Grant and Hampshire than in any of the others.

*These tables are placed at the end of this Bulletin.

Northeastern Mountain Counties—Table 2.

From reports it will be seen that Yarrow[98] is considered the worst weed in this region; the Ox-eye Daisy[99] ranging second and Broom Sedge[191] third. The Blue Thistle[125] so prominent in the Valley Counties, also extends into these; while the Broom Sedge,[191] which will appear as one of the principal weeds westward, seems to end its eastern course with these counties, not passing as yet into the Valley Counties to any extent.

Eastern Mountain Counties.—Table 3.

In the eastern Mountain Counties, the Wild Carrot[59] is according to the table considered the worst weed, although the Ox-eye Daisy[99] is reported more frequently.

In our journey toward the south and west, through these tables, the Broom Sedge[191] is now become to be considered more frequently as a bad weed, as is also the Buck Plantain.[159] The Blue Thistle[125] and Canada Thistle[108] still remain as dreaded plants, while the Teasle,[70] Sand-briar,[132] and Blue,[80] and White Devils,[79] which we will grow sadly well acquainted with as we pass westward through the State, are noted here in their easternmost extension.

Northern Counties.—Table 4.

According to the table, the Ox-eye Daisy[99] is considered the worst weed in the Northern Counties, being the first mentioned by 19 out of 25 observers. Broom Sedge[191] ranks second, and Bitter Dock[167] third.

The peculiarities of this section are as follows: The total absence of any report of Wild Carrot[59] in Marion County, while every observer in Taylor County, which lies adjacent, reports the weed. The absence of report upon the Common Thistle,[105] except in Preston County; the prominance given to the Iron Weed[72] in Marion County, while none but myself think it a bad weed in any other; and the utter ignoring of the Spanish Needle,[95] which is known to be very prevalent throughout the region.

Were the Teasle[70] better known by name, it would doubtless have been reported upon more frequently, as it is quite common in these counties. The Blue Thistle[125] and Canada Thistle[108] so frequently reported in the previous sections are entirely absent in this.

North-Western Ohio River Counties—Table 5.

From the tabulation compiled as reported, the Wild Carrot[59] is decided upon as the worst weed in the North-western Ohio River Counties, the second worst the Ox-eye Daisy[99] and Bitter Dock[167] the third.

The Sand-briar[132] does not seem to receive the number of votes here that it should, as I feel certain that it bids fair to be the very

worst weed throughout the extent of the River Counties. Wild Flax[138] is intruding its spikes of yellow flowers throughout this section, the little notice it has received being in all probability due to the lack of knowledge concerning its names as given in my query. The Canada Thistle[illegible] is shown to extend only to Marshall County, which I judge to be correct. Golden Rod[illegible] is doubtless rightly considered as to its range and greatest prevalence. Broom Sedge[191] substantially begins to be a pest in Pleasants and as will be seen by the next following table continues to the southern limit of the State; future tables will show its progress eastward from the river counties. The White Devil[79] and its sister species the Blue Devil[80] also begin their obtrusive frequence here, and will be found further on to receive more attention in the southern and central counties. Why Wetzel County should proclaim so plainly against Spanish Needies[95] while the balance of this district is silent, can only be answered by the supposition that the observers of that county are probably more interested in sheep as wool producers than those of the other counties. Wood here begins the complaint against the Wild Sweet Potato[127] that is taken up with more vehemence as we pass on southward and eastward. Yarrow[illegible] receives considerable attention in this section, but it is not even mentioned in the counties farther down the river. The Buck Plantain[159] a perfect nuisance from here on, receives its merited attention.

Southern Ohio River Counties.—Table 6.

In the southern tier of Ohio River Counties, the Blue Devil[80] is shown to reach its rank of King-of-bad-weeds there, having for its consort the Broom Sedge,[191] and its retinue Bitter Dock,[167] Cockle-bur,[90] and Spanish Needles.[95] From this line of reports, we must judge that our observers live mostly upon the fertile bottom lands of the River. Our surmise is sustained by the absence of reports on Sorrel[168] and Cinquefoil.[47]

The Ox-eye Daisy,[illegible] up to this date, seems to have ceased in its progress down the river after passing through Jackson County, and to seek here an eastern extension, as the following tables will show. The Wild Carrot[illegible] spreads downward one county farther before moving east. Wing Stem[illegible] a weed that seems to come down the feeders of the Ohio, is probably not reported to greater extent on account of the lack of a name being known for it. The Sand-briar[132] would probably have received more attention had we gained more reporters in Cabell and Wayne; though I judge from personal observations that it turns eastward at about the mouth of the Great Kanawha in Mason County. Why the White Devil[79] should lack consideration in Jackson and Mason I can not decide, as it is certainly quite prevalant in both.

Northern Central Counties—Table 7.

In tabulating the Northern Central Counties, I have been forced

to leave out Calhoun and Gilmer, as I have no reports whatever from them. My own observations there are on record among my notes, but without the corroboration of others there I do not feel like using them in this table.

An examination of the table will show that Broom Sedge[191] is entitled to the first rank as a bad weed in this section; the Sandbriar[132] second; and the honors of the third place equally divided among Blue Devils,[8] Ox-eye Daisies[99] and Elders.[66]

The points of interest developed by the table are as follows: The Canada Thistle[103] is only to be found in two counties, viz: Harrison and Doddridge; the Teasle[illegible] in Barbour, Harrison and Upshur. Field Garlic[illegible] is only complained of in Barbour. The Wild Sweet Potato[127] appears only to be a nuisance in the westernmost counties of the section; while the Blue Devil[8] does not become particularly obnoxious until south of the northern tier of the section, which bounds also the Northern Counties where this weed is not particularly prevalent.

Southern Central Counties—Table 8.

The meagre reports from the Southern Central Counties with absence of any from Boone, render the standing of the worst weeds somewhat uncertain. Broom Sedge[191] might, however, be considered the worst, with the Ox-eye Daisy[99] second, and White Devil[79] third.

Southern Boundary Counties—Table 9.

The absence of any reports whatever from Logan and Wyoming Counties, and the meagre returns from Raleigh and McDowell, render remarks upon this table too unsatisfactory. They are, therefore, omitted.

Summary—Table 10.

The three worst weeds in the State are, therefore, Ox-eye Daisy,[99] Broom Sedge,[191] and Wild Carrot,[illegible] according to those who have weeds to deal with. All things considered, however, the Canada Thistle,[103] Broom Sedge,[191] and Blue Thistle,[125] prove to be the worst according to the discredit of bad points.

From the foregoing tabulations, and the tables of bad points, I have been able to select the following, as the fifty worse weeds of this State:

THE 25 WORST WEEDS.

1. Ox-eye Daisy,[99]	(Chrysanthemum Leucanthemum, L.)
2. Broom-Sedge,[101]	(Andropogon Scoparius, L.)
3. Pasture Thistle,[105]	(Cnicus lanceolatus, L.)
4. Burdock,[104]	(Arctium Lappa, L.)
5. Bitter-Dock,[167]	(Rumex obtusifolius, L.)
6. Wild Carrot,[59]	(Daucus Carota, L.)
7. Elders,[66]	(Sambucus Canadensis, L.)
8. Ironweed,[72]	(Vernonia Noveboracensis (L.), Wild, and altissimus, Nutt.)
9. Yarrow,[98]	(Achillea Millefolium, L.)
10. Buck Plantain,[159]	(Plantago lanceolata, L.)
11. Cockle-bur,[90]	(Xanthium Canadense, L.)
12. Blue Thistle,[125]	(Echium vulgare, L.)
13. Rag Weed,[88]	(Ambrosia artemisiaefolia, L.)
14. Spanish Needles,[95]	(Bidens bipinnata, L.)
15. White-top,[82]	(Erigeron annuus, L.)
16. Sand-briar,[132]	(Solanum Carolinense, L.)
17. Sorrel,[168]	(Rumex acetosella, L.)
18. Garlic,[178]	(Allium vineale, L.)
19. White Devil,[79]	(Aster latcriflorus (L.), Britt. var hirsuticaulis, (Linol), grag.)
20. Blue Devil,[80]	(Aster Cordifius, L., var laevigatus, Port.,
21. Canada Thistle,[108]	(Cnicus arvensis (L.), Hoffm.)
22. Morning Glory,[126]	(Ipomoea purpurea (L.), Lam.)
23. Wild Sweet-potato,[127]	(Ipomoea pandurata (L.), Meyer.)
24. Dog-fennel,[97]	(Anthemis Cotula, L.)
25. Cinquefoil,[47]	(Potentilla Canadensis, L.)

Several others might be added to this list, which, however, is already almost too bulky to handle. Such weeds as the Naked-weed,[112] Skeleton-weed,[112] Devil's Grass,[112] or Hog-bite;[112] (Chondrilla juncea, L.); the Glenn-weed,[15] Glen-pepper,[15] Crowd-Weed,[15] or English Peppergrass:[15] (Lepidium campestre,); Chess:[196] (Bromus secalinus, L. & racemosus, L.); and numerous others, which we will treat at length in Part 3 of this bulletin.

SECONDARY LIST OF WORST WEEDS.

26. Briars,[45]	(Rubus villosus Ait. & Canadensis, L.)
27. Mullein,[136]	(Verbascum Thapsus, L.)
28. Wild Cotton, Milk Weed,[119]	(Asclepias Syriaca, L.)
29. Wild Parsnip,[62]	(Pastinaca sativa, L.)
30. Indian Hem,[117]	(Apocynum androsaemifolium, L.)
31. Poke Weed,[165]	(Phytolacca decandra, L.)
32. Teasle,[70]	(Dipsacus sylvestris, Mill.)
33. Golden Rod,[77]	(Solidago juncea, Ait.) (mostly.)
34. Smart Weed,[169]	(Polygonum) (several species.)
35. Horse Weed,[113]	(Lacuta Cnadensis, L.)
36. Wild Flax,[138]	(Linaria vulgaris, Mill)
37. Indian Mallow,[28]	(Abutilon Avicennae, Gaertn.)
38. Fox Tail,[190]	(Setaria glauca, (L.) Beauv.)
39. Crab Grass,[169]	(Panicum sanguinale, L.)
40. Elecampane,[85]	(Inula Helenium, L.)
41. Stick Seed,[41]	(Desmodium (numerous species.)
42. Corn Cockle,[20]	(Lychnis Githago, L.)
43. Beggar's Lice,[95]	(Bidens frondosa, L. & Connata, Muhl.)
44. Jimson Weed,[135]	(Datura Stram L. & Tatula, L.)
45. Shepherd's Purse,[13]	(Capsella Bursa-pastoris, L.)
46. Tar Weed,[54]	(Cuphaea petiolata, (L.) Koehne.)
47. Wing Stem,[93]	(Actinomeris alternifolia, (L.) D.C.
48. Spiny Amaranth,[161]	(Amarantus spinosus, L.)
49. Tall Ragweed,[87]	(Ambrosia trifida, L.)
50. Nigger Head,[91]	(Rudbeckia hirta, L.)

BAD POINTS OF WEEDS.

Plant species like animals are in a constant state of strife with each other. They are all provided with some means more or less efficacious of both gaining a livelihood and perpetuating their species. Those first procuring a foothold in any given locality have a natural tendency to crowd out others, the larger tend to smother the smaller or prevent their seeds from germinating properly; the perennials to supersede the annuals; and the most profuse seed bearers to gradually occupy most of the space near the parent plant.

In considering the bad points of weeds, I shall calculate them much as a fancier would the good points in his pet animal, but of course reversed, for it is easily understood that all those attributes that are good points in a useful plant, naturally become bad attributes when that plant exists as a weed.

The ten principal bad points are as follows:

1. Prevalence.

This point I have determined from the preceding pages, which give substantially the observations of my reporters throughout the State; they are necessarily incomplete. In the following tables of bad points, this one is of course arbitrarily averaged from that source for the whole State. Any one of the weeds may be high in prevalence in one locality and very low in another. Such a weed as the Rag Weed[88] can be easily understood to merit (10) the highest grade, as it is found everywhere in the State and plentiful wherever it grows. Others are not so readily rated.

2. Seeding Capacity.

Some weeds are known to produce great quantities of seed, others but little, this point is easily understood and almost always readily determined.

3. Dissemination of Seeds.

A wide difference exists among plants as to the power they may

possess of self-distributing their seeds. Some have no known method of accomplishing this end, others have peculiarly efficient means. The gradation between that plant whose seed pods simply fall with the plant unopened, and that which has no pod, but whose surrounding tissues actually spread back out of the way while the seeds in the meantime produce feathery sails with which the least zephyr will waft them long distances and finally drop them point downward to the soil, is very gradual. The former plant would merit but a single (1) point here, while the latter would readily score ten (10).

4. Root and Stem Propagating.

Under this rubric are scored all methods for plant reproduction except by its seed. Some plants have actually no method of reproduction except by seed, whereas others like the Canada Thistle[108] are capable of plentifully reproducing without.

5. Resistence to Eradication.

There is no use of explaining this point to those who have toiled and sweat over the Common Elder[66], the Sumach[34] and the Sand-briar[132], or who have smiled as they struck the weakling with their hoe and turned its tender roots upward to the pitiless sun.

This point is really a combination of points 1, 3, and 4.

6. Aggressiveness.

The persistence of a weed to spread in spite of hard labor expended against it; the rapidity of its traversing an extended area and its determined effort to occupy the soil to the exclusion of useful plants; together with other items of like nature, go toward making such weed an aggressive one.

7. Robbing the Soil.

Some weeds extract from the soil to aid in their nutrition much more of those elements needed by the farmer to support his crops than others. We have at this station done all that time would allow us to get at this matter thoroughly in regard to weeds. In the table of points, I have expressed this quality of robbing the soil by the same range of figures as other points, but here the figures also mean dollars and cents as will be understood by reading Part 1 on weeds as Fertilizing Material. For example, I rate Iron Weed[72] as 10 as we know it to remove $10.63 worth of fertilizing matter from the soil per dry ton; the Broom Sedge[191] is rated as 3 as it robs the farmer of $3.03 worth of the substances needed for his crops.

8. Recognition of the Plant.

Those weeds that are well known by the farmer wherever he sees them, like the Rag Weed[88] are considered low (2) in this bad quality; while such plants as are newly coming into our farms take higher values in this regard, as many farmers fail to know the plants or recognize their bad qualities when they see them. None, however, have been ranked higher than eight (8) as they will be known in some sections of the State if not in others.

9. Longevity.

Some weeds live but a short time even if left to themselves, not even meriting the rank of an annual; others live one or two years; others a few seasons, and others seem to have a tendency of outliving the farmer himself; their rank in point here is therefore usnally easy to decide upon.

10. Obnoxiousness.

Some weeds have other bad qualities beside their mere presence where they are not desired. Some take a high rank under this head as dangerous poisons either to man or domestic animal; such as the Cow's Bane[63], Wild Parsnip[62], Green Hellebore, Laurel, Stagger Bush, Indian Tobacco[115], etc; others have briars or strong prickles which tear the clothing or wound cattle; others have seeds that injure the quality of wool, or render animals restive, or restless and ill from irritation; like Burdock[101], Spanish Needles[95,96], Beggar's Lice[41], some Grasses etc; others still yield a sticky substance that utterly ruins wool in the market; as the tar weed[54], etc. All these are qualities that tend to alter the points in the scale of obnoxiousness.

There are numerous other bad points in weeds that deserve more or less consideration; but I have carried the matter as far as necessary, and consistent in the table appended. Such points may be mentioned, however, as a matter for thought. They are:

Recognition of Seed.

This is a point of great interest and of frequent use in our laboratory, and one also very useful indeed to the Agriculturist. This point in connection with

Separation of Seed,

that is to say the ease or difficulty attending the separation of the weed seed from that of useful plants, would certainly be very desirable thing for every farmer to know, that he might be able not only to recognize but to separate all weed seeds from his sowings.

Both, however, would require great pains, time and labor, as well as some relatively costly apparatus. I deem it more important, therefore to work toward a seed control in the State than to attempt to teach the farmer that which he has no time to learn nor put in practice. As to seed grown by himself, he will naturally see to it that it is kept free from weeds should he look out as usual for his own interests. Another point might be made upon

The Vitality of Weed Seeds.

But as I have as yet had no time at this Station to thoroughly test the matter, I prefer not to treat of this doubtful question.

Forage Value.

This point might also be made a subject of comparison had our Chemist had more time for such analyses as would be necesary. As it is, the chapter upon that subject must suffice at least for the present.

The chances of a weed harboring fungi or injurious insects might also be considered here had our publication been delayed a sufficient length of time to carry on such investigation.

We feel assured, however, that we have presented the subject as fully as we could do it justice, and hope that it will teach those who desire to learn something at least of the methods that might be followed to gain a knowledge of the true nature of weeds.

Many of the conditions change in different localities; we have therefore in the table attempted to average them as nearly as possible for the whole State.

	Prevalence	Seeding capacity.	Dissemination seed.	Root and Stem propag'n.	Resistence to Eradication.	Aggressiveness.	Robbing Soil.	Recognit'n of Plant.	Longevity.	Obnoxiousness.	Total bad Points.
Ox-eye Daisy (1)*	6	10	8	6	8	10	10	6	4	10	78
Broom-sedge (2)	6	8	10	8	10	10	3	4	8	10	77
Thistle (3)	8	10	10	5	4	4	10	2	6	5	64
Burdock (4)	6	6	8	2	6	5	10	2	8	10	63
Bitter-dock (5)	6	10	4	4	4	2	10	4	8	4	56
Wild Carrott (6)	6	10	8	2	10	10	10	6	8	10	80
Elders (7)	5	5	2	10	10	4	7	2	10	4	59
Iron-weed (8)	8	6	4	4	4	4	10	2	4	4	50
Yarrow (9)	7	8	6	2	4	6	10	5	6	6	60
Buck Plantain (10)	7	10	6	2	6	10	?	6	8	6	61†
Cockle-bur (11)	6	6	7	4	5	5	10	5	4	5	57
Blue Thistle (12)	6	10	6	10	8	10	10	6	10	10	86
Rag-weed (13)	10	10	4	2	5	8	7	2	2	6	56
Spanish Needles (14)	10	8	8	2	2	10	7	2	4	10	63
White-top (15)	10	4	4	4	7	5	?	5	3	5	47†
Sand Brier (16)	8	4	4	4	10	10	?	5	8	10	63†
Sorrel (17)	8	8	4	4	2	2	7	6	8	4	53
Field Garlic (18)	6	5	4	0	10	10	?	2	4	10	51†
White Devil (19)	8	7	5	5	10	10	9	4	4	8	70
Blue Devil (20)	8	7	5	5	10	10	8	4	4	8	71
Canada Thistle (21)	4	10	10	10	10	10	7	4	10	10	85
Morning Glory (22)	6	4	4	2	4	5	?	2	2	8	37†
Wild Sweet Potato (23)	8	4	4	8	4	6	?	3	8	8	53†
Dog Fennel (24)	8	5	4	2	4	2	?	6	6	4	41†
Cinquefoil (25)	8	3	3	8	5	5	?	4	10	5	51†
Briars (26)	8	4	2	10	10	8	9	2	10	10	73
Mullien (27)	4	4	2	4	3	4	?	2	4	5	32†
WildCotton, M'kW'd(28)	6	8	10	2	4	4	8	2	2	4	50
Wild Parsnip (29)	6	10	6	4	6	8	?	2	6	8	56†
Indian Hemp (30)	5	6	10	4	4	6	7	5	6	6	59
Poke Weed (31)	6	4	2	6	4	4	20	1	6	4	57
Teasle (32)	4	4	4	6	4	10	?	5	6	10	55†
Golden Rod (33)	10	6	6	4	4	4	7	2	4	5	52
Smart Weed (34)	6	10	2	4	4	4	?	2	2	6	40†
Horse Weed (35)	4	8	10	3	4	4	10	5	3	6	57
Wild Flax (36)	2	6	2	2	2	6	10	7	5	10	52
Indian Mallow (37)	2	4	2	2	2	4	?	2	2	8	28†
Fox-tail (38)	10	6	2	2	10	10	10	2	2	6	60
Crab Grass (39)	10	6	2	2	10	10	10	2	2	10	64
Elecampane (40)	2	8	10	4	4	4	?	2	4	4	42†
Stick Weed (41)	5	6	6	4	3	4	9	2	2	10	51
Corn Cockle (42)	3	5	2	0	2	5	?	2	2	10	31†
Beggar's Lice (43)	4	6	6	2	4	4	?	2	2	8	38†
Jimson Weed (44)	4	10	4	2	2	2	?	2	4	4	34†
Shepherd's Purse (45)	4	8	2	0	4	5	?	2	2	4	31†
Tar Weed (46)	5	3	2	4	4	6	?	6	5	6	41†
Wing Stem (47)	3	10	5	4	6	4	10	8	5	4	58†
Spiny Amaranth (48)	2	4	4	5	6	10	?	6	5	10	50†
Nigger Head (49)	3	4	3	2	6	10	?	2	4	10	44†
Tall Rag Weed (50)	6	6	3	3	4	4	?	4	5	4	39†

*These figures refer back to the Tables of Worst Weeds on pp. 190-91.

Weeds as Fodder for Stock.

One of the questions asked of my observers was: "Do you consider any of your weeds good fodder, if so which, and for what animals."

In answer to this question 98 reporters treated it with silence, doubtless judging the question too absurd to require reply of any kind; 103 answered briefly "none;" while 70 stated positively that "Rag Weed" is good fodder for sheep if carefully and properly cured." The balance of the answers were scattered and will be found elsewhere in their place. A number stated some plant or plants that pigs or horses would eat, but I judge that they hardly consider these as actually falling under the head of fodders.

Cattle will not refuse to take both Buck Plantain[159] and the Common Plantain[158] along with the grass upon which they are browsing, neither will they refuse Broom Sedge,[191] Stick Weed,[79] and numerous others while these are young and fresh, but I doubt if they would thrive were they turned in upon any of these plants alone. I am sorry not to be able to state this positively, but our analyses have not yet reached these weeds.

Many weeds might be excellent fodder were it not for the bitter principles or milk and beef infecting substances that they contain. Some weeds actually refused outright in a green state by cattle, are eaten readily when they are properly cured with the hay, yet they can hardly be classed as fodders, for cattle could not thrive on them alone. Horses are known to be fond of nibbling at or even eating quite a quantity of Wild Lettuce,[113] Iron Weed,[72] Oak leaves, Briars,[15] Burdock[101] or Hickory leaves; and I saw a cow last summer deliberately walk up to a Jimson Weed[135] and eat several mouthfuls of the leaves with evidence of pleasure at her taste; yet we would not class these plants as proper animal food.

It is a well known fact that animals often seek in the plants that surround them the remedies needed for their slight ailments, evidencing a reasoning power far beyound their supposed intelligence. Some act of this sort—like the cow and the Jimson Weed,--might mislead some into the supposition that such chosen plant was considered by the animal to be good fodder.

Some Wild Grasses and plants of our forests are really excellent food for cattle, prominent among them the Wild Pea Vine (**137**) and Deer Tongue Grass. There are some sections of the State where the woods abound in these and other natural foods rich in

nitrogen, whereon cattle flourish excellently well; but these plants can hardly be called weeds as very few of them ever show the least tendency to intrude upon the cultivated soils of the farm.

As to the question of carefully cured Rag Weed[88] being good fodder for sheep, in which so many of my correspondents concur: I can readily understand this weed to be a good fodder, for sheep seem by nature to require considerable bitter substance for their health and well being; and Rag Weed shows at the same time by the analysis of our Chemist a large per cent. of nutritive substances, in fact nearly as much as the average Timothy Hay. In point of fact, if Timothy Hay was worth $10 per ton as fodder for sheep, Rag Weed would be worth $8.25 for the same purpose. This would hardly prove true in case of other animals, unless it might be for steers whose beef was not intended for market at the time of such feeding. I noticed upon several farms in Randolph County last season a large number of dark colored stacks in fields where there were also a number of stacks of hay. Upon examination, I found these to consist almost exclusively of Rag Weed, and upon inquiry as to its use was told by the farmer that he always cut and carefully cured the Rag Weed of his stubble fields and stacked it in his sheep pastures near his hay; and further added that often sheep would remain at the Rag Weed stacks for days at a time utterly ignoring the presence of the hay.

One of my correspondents states in good faith that "Ox-eye Daisy[99] is better fodder for cattle than Clover if cut when in bloom." We must differ with this statement, for it is known not even to be as good, for if clover was worth $20 per ton, Ox-eye Daisy would only bring $14.90 at the same rating. Then again as a matter of taste, if he should buy a ton of each for his cattle and allow them free access to both, his $20 hay would be all gone before the Ox-eye Daisy was touched, and the cattle would be apt to wait until they were sure no more clover was forthcoming before they would even look at the cheaper article. I would not grow Ox-eye Daisy upon any such statement as that of my correspondent, nor would you upon my statement of its nutritive value as compared with clover. The Ox-eye Daisy is a weed; it has been proven to be the worst weed in the State, that is enough to settle the fact that it is worse than useless to us.

Ox-eye Daisy might be worth something as fodder if we could import it from some country at the other end of the earth, properly cured, and all the seed guaranteed to be positively dead.

Our Chemist has analyzed other weeds to determine their nutritive value, all of which will be found in Part 3 of this Bulletin under the consideration of the weeds themselves.

There is no doubt but that these careful analyses that we are now instituting at this Station might show a few weeds to be passable fodder. I will conclude, however by stating positively that there is not a weed in this State worth cultivating as fodder for stock.

The Use of Chemicals as Weed Exterminators.

In answer to my question: "Do you ever use any chemical or like remedy against weed growth, if so, what, and for what weeds?" One hundred and eighty-five correspondents answered "No," and sixty-five left the question unanswered.

Among the specific answers, most of the reporters mention the use of salt to kill Elders, Dock, Iron Weed, Plantain, Canada Thistle, Ox-eye Daisy and Cinquefoil: while one stated positively that "salt will not kill Docks." Salt may be used for this purpose in four ways (1) By cutting off the larger plants at the summit of the root a few inches beneath the ground and throwing in the cavity so made a large handful. If this is thoroughly and carefully done, I can easily understand that it might prove very effective indeed. (2) By sowing salt freely about over the weedy spots after surface cutting the growth. This method might kill some weeds, but can not prove satisfactory in general. (3) By proceeding as before, but turning in stock to feed where the salt was strewn, this would probably benefit the stock, but would generally fail to kill the perennial weeds. (4) By pouring cold or hot brine upon the cut ends of weeds or their roots. In this case, if the soil was quite loose and the method thoroughly carried out, it might prove very effective indeed. Salt will certainly kill vegetation, but it must be used in great quantity and would therefore be applicable only to very limited areas indeed.

Lime used profusely has often met with partial success as a weed exterminator. Its use on weeds growing in soils known to be lacking in that element would serve a double purpose as the weeds would be of a nature to be most badly effected by its use; while the land would be thereby improved for crops needing it.

The use of coal oil or kerosene as a weed exterminator can not be recommended as it will prove too costly, and at the same time only effective when poured liberally upon small areas of soil.

Sulphuric Acid will kill any weed of no matter of what nature, yet strong as it is, it must be applied directly to each individual root-stock whose eradication is desired, thus rendering the process a tedious and costly one. The Sulphates of metals, like sulphate of zinc, (white vitriol), sulphate of copper (blue vitriol), etc., might be used in the same way, and prove efficacious, but the cost is to be considered.

Experience and experiment have conclusively proven that any extended use of chemicals as weed killers is always attended by more expense and labor than the results can possibly compensate for.

Table 1—Valley Counties.

COUNTY.	OBSERVER.	Blue Thistle[125]	Glenn-weed[15]	Canada Thistle[108]	Field Garlic[178]	Ox-Eye Daisy[99]	Naked-weed[112]	Water Cress[11]	Sorrel[168]	Wild Carrot[59]	Dog Fennel[97]	Boar Thistle[105]	Burdock[104]	Wild Parsnip[62]	Corn Cockle[20]	Wild Poppy[8]	Spanish Needles[95]	Buck Plantain[159]	Yarrow[98]	Wild Flax[138]	Bitter Dock[167]	Nigger Head[91]	Smart-weed[169]	Teasle[70]	Sweet Clover[39]
Jefferson.	5			3	2	1																			
	6			4	1		3				2														
	35		2	3				1																	
	47		1	3				2																	
	78	2	1	3																					
	91	1		2																					
	153	1							2																
	176	1			2																				
	177	1	2				3																		
	183	1	5			3			4		2														
	184								1	3		2													
	Author.	1	3	4	2	6	7			5		8													9
Berkeley.	62												1												
	67	1			3	2																			
	79	3			1										2										
	117		2					1								3									
	155	2	4		5	3				1				8			6	7							
	199	1			4			5		3								2							
	Author.	1				2	4			3			5	6	9				7	8					10
Morgan.	175	2			4					3											1				
	Author.	1				2													3			4			
Hampshire.	4	5		3	4	1								2											
	66										2												1		
	71					1																			
	92	1				3								2											
	119	3		5		2				1													4	6	
	126	2			1	3	4		5																
	171	3				1				2															
	216	2								3	1														
	226	1							2										3						
	227	3				1				2									4						
	233					1				4	3	2							5						
	Author.	1									2			3					5					4	

Table 1—Valley Counties.—Continued.

COUNTY.	OBSERVER.	Blue Thistle[125]	Glenn-weed[15]	Canada Thistle[108]	Field Garlic[178]	Ox-Eye Daisy[99]	Naked-weed[112]	Water Cress[11]	Sorrel[168]	Wild Carrot[59]	Dog Fennel[97]	Boar Thistle[105]	Burdock[104]	Wild Parsnip[62]	Spanish Needles[95]	Buck Plantain[159]	Yarrow[98]	Wild Flax[138]	Teasle[70]	Brocm Sedge[191]	Cinquefoil[47]	Jimson Weed[135]	Wild Sweet Potato[127]	Cockle Bur[90]	Sweet Clover[39]
Hardy.	44	1				2									3			4		5					
	156	3		1		5					4								2						
	239	4				2										3	5				1				
Mineral.	46	3							1												2	4			
	61					3																	1	2	
	161	3				2				1												5	4		
	232	4				1				3						2									
	Author.	1								3								4							2
Grant.	45	1				2				4			6	5										3	
	144															1									
	165	1		4		2			6	3			5			7	8								
	188					1																			
	192	2				1				3						4									
	242	4				1				2			3			6								5	
	272								2							3	1								
	284	3				1				2										4					
	Author.	1				2				3				4			5								
Pendleton.	70	3				2				1															
	268	4				2				1	5			3											

Table 2.—Northeastern Mountain Counties.

COUNTY.	OBSERVER.	Wild Flax [138]	Yarrow [98]	Spanish Needles [95]	Buck Plantain [150]	Broom Sedge [191]	Bitter Dock [167]	Blue Thistle [125]	Ox-eye Daisy [99]	Wild Carrot [59]	Burdock [104]	Cinquefoil [47]	Sorrel [168]	Rag Weed [88]
Tucker.	195	1	2	3	4	5								
	222			1	3		2	3						
	263					4		2	1	3				
	Author.		1			4			3	2				
Randolph.	88		1			3					2			
	99		4		5	3		1	2					
	198		2	4	1				3					
	269		2		3	4			1					
	Author.		2						1			3	4	5

Table 3- Eastern Mountain Counties.

COUNTY.	OBSERVER.	Broom Sedge [191]	Buck Plantain [159]	Yarrow [98]	Ox eye Daisy [99]	Sand Briar [132]	Spanish Needles [95]	Sorrel [168]	Cinquefoil [47]	Dog Fennel [97]	Bitter Dock [167]	Blue Thistle [125]	Blue Devil [80]	Rag Weed [88]	Burdock [104]	Wild Carrot [59]	Canada Thistle [108]	White Devil [79]	Teasle [70]	Beggar's Lice [41]	Wild Sw't Potato [127]	Nigger Head [91]
Webster.	64	1	2	3	4																	
	246	4		1		2	3															
	Author	2		3		1																
Pocahontas.	139			3				1	2	5	4											
	151		2		3						1											
Greenbrier.	30	2		3	1							4				5						
	142				2		1						3	4								
	152			1	2						4	3										
	160				1		2				4		3									
	210				4		5		3	2			6		1							
	218	4		7	3		6			8		5			2	1						
	223		5	2	3	4	6						7			1						
	Author	5		2		4						6				1	3		7			
Summers.	19		2	3	1												4					
	55	1		2						3												
	80		2	3	1																	
	100			2	1			3		4												
	244	3								4						1		2				
	Author	5				2										1			3	4		
Monroe.	85		3		2											1						
	145	1	5	3							4				2	5						
	158										4				3	1				2		
	214	1	4		3											2						
	219	4			3	1															2	5

Table 4—Northern Counties.

COUNTY.	OBSERVER.	Common Thistle[105]	Elders[36]	Bitter Dock[167]	Ox-Eye Daisy[99]	Rag Weed[88]	Yarrow[98]	Burdock[104]	Wild Carrot[59]	Teasle[70]	Buck Plantain[159]	Garlic[178]	Broom Sedge[191]	Iron Weed[72]	Cinquefoil[47]	Wild Sweet Potato[127]	Briars[45]
Preston.	17	1	2	3													
	37			3	4		2										
	58				2			1	3								
	93				1					2							
	109		3	4	1				2								
	110	5			2				6		1	3	4				
	127	3	4		1				2								
	148		4	3	1			5	2								
	157	5		2	1		3	4									
	187	2								3			1				
	196		3	4	1	5		2									
	217	4		2		1				3							
	262			3	1					2							
	Author.			3	1		2		4				5				
Monongalia.	10					1	4		2		3						
	48				1								2				
	Author.				1	8	6		4	5	3		2	7			
Marion.	2		3		1								4		2		
	11		1	3							4			2			5
	27		1		3					2	5		6	4			
	29		4	4	1		6						5	3			7
	43													2		3	1
	94						5				3		1	2		4	
	115			2	1		5				4			3			
	120			4	1					3				2			
	205		1	2			3				4						
	259		4	3	1									2			
	271		3	4									2	1			
	276		1	3										2			
	Author.				1		4			5			3	2			
Taylor.	83				2		7		3	6	4		5				1
	181			4			5		2		3		1				
	220				1		2		5		3		4				
	243				1		4		2		5		3				
	261				1		4		3				2				
	Author.				2				1	4			3				
Total...............		6	13	18	25	4	15	4	14	10	12	1	17	12	1	2	4

Table 5—Northwestern Ohio River Counties.

COUNTY.	OBSERVER.	Golden Rod[77]	White Top[82]	Sorrel[168]	Wild Flax[138]	Yarrow[98]	Wild Carrot[59]	Canada Thistle[108]	Bitter Dock[167]	Elders[66]	Common Thistle[105]	Teasle[70]	Briars[45]	Sand Briar[132]	Ox-eye Daisy[99]	Broom Sedge[191]	Buck Plantain[159]	Rag Weed[88]	Wild Sw't Potato[127]	Spanish Needles[95]	Burdock[104]	Cockle-bur[90]	Iron Weed[72]	Blue Devil[80]	Dog Fennel[97]	White Devil[79]
Hancock	23	1	2	3	4	5																				
	185	3	4	1		5		2																		
	240				1		2		3																	
Brooke.	9					2		1	3	4																
	18									2	1															
	164					3	1				2	4														
	193						1						2	3	4	5										
	250					3	2		4	1	6	5														
Ohio.	16		1					5			3				2		4	6								
	54		1	3							2							4								
Marshall.	49	1			2													3	4							
	50		3			4						1			2											
	107	2				4	5		1			3						6								
	111		3			5	4		1			2														
	131		3				2											1								
	138			2					3			4							1							
	234	1	3			2												4								
Wetzel.	14		1				3					6								2	4	5				
	21					4			3								5			2	1					
	33		5				1			3	2	4					6									
	59					3	4		7	5							6				2	1				
	60		5				4		6	3	2										1					
	69		3								2						1			5		4				
	123		3			5	6		1	2							4									
	124		4	5		3			2			6								1		5				
	162								2											4		3				
	179								1											2		3				
	237					6			3	2							1			4		5				
Tyler.	112		5	1					3								2	4		6						
	204		2	4			7					6					5	1		5						

Table 5—Northwestern Ohio River Counties. –Continued.

COUNTY.	OBSERVER.	Golden Rod[77]	White top[82]	Sorrel[168]	Wild Flax[138]	Yarrow[98]	Wild Carrot[59]	Canada Thistle[108]	Bitter Dock[167]	Elder[66]	Common Thistle[105]	Teasle[70]	Briars[45]	Sand Briar[132]	Ox-eye Daisy[99]	Broom Sedge[191]	Buck Plantain[159]	Rag Weed[88]	Wild Sw't Potato[127]	Spanish Needles[95]	Burdock[104]	Cockle-bur[90]	Iron Weed[72]	Blue Devil[80]	Dog Fennel[97]	White Devil[79]
Pleasants.	197					5	1			4						2							3	6		
	211					2				4					3							1	5			
Wood.	1			1			4						2		3											
	28						1								2			3							4	
	31					5	3							7	1		5	2	6						4	
	53													1	2				3							
	57		4				2								1		3		5							
	74		2															1	3							
	89		5			2											1		4							3
	101		1				3								4				2							
	104			1			5						2		4	6	3		7							
	118						2								1		4		8							
	203					5							1	3		2	4									
	206						2								1		3		4							
	209					1								3	2											
	228																								1	
	258						1												2							
	Author.						3							1	4	5			2							

Table 6 - Southern Ohio River Counties.

COUNTY.	OBSERVER.	Bitter Dock[167]	WildSweet Potato[127]	Broom Sedge[191]	Buck Plantain[159]	Blue Devil[80]	Cockle-bur[90]	Wild Carrot[59]	Ox-Eye Daisy[99]	White Top[82]	Sand-briar[132]	Common Thistle[105]	Spanish Needles[95]	Elders[66]	Sorrel[168]	Wing Stem[93]	Tall Rag Weed[87]	Wild Lettuce[113]	Morning Glory[126]	Cinquefoil[47]	Iron Weed[72]	White Devil[79]	Dog Fennel[97]	Teasle[79]
Jackson.	8	1	2	3	4																			
	15	2				1	3					4												
	51						3	1	2				4	5										
	72	2	3	1																				
	75	2		1	3								4											
	121				2			1		3			4	5										
	140		3	2							1	4												
	200	1		3		4	2			5				6										
	201	1	5	4		3					2													
	215	2			4						3			1										
	224	6		2	1		4		3	7			5											
	256	2	4	3		1	6			5			7											
	273				5	1			2				3	4										
	Author.	3	4				2		1	5														
Mason.	25			3		1	4					2	5											
	170		3	2		1	5	4					6											
	172			4			6	3			2		5		1			7						
	Author.							1			2					3	4	5	6					
Cabell	82			2	3		4						5			6				1				
	194	4		5						3						1					2	6		
	229	6					3			2			4								5			
Wayne.	86	3	5	4			6						7									1	2	
	98			2									3	4								1		
	178	7		4			5						1		3							2	6	
	267	2		1			3						4										5	6

Table 7 — Northern Central Counties.

County.	Observer.	Elders[66]	Bitter Dock[167]	Teasle[70]	Sand-briar[132]	Broom Sedge[101]	Wild Carrot[59]	Yarrow[98]	Ox-eye Daisy[99]	Cockle-bur[90]	Buck Plantain[159]	Field Garlic[178]	Wild Sw't Potato[127]	Burdock[104]	Briars[45]	Canada Thistle[108]	Spanish Needles[95]	Iron Weed[72]	Common Thistle[105]	Rag Weed[88]	Blue Devil[80]	White Devil[79]	Sorrel[168]	Dog Fennel[97]	Wild Flax[188]
Barbour.	56	1	2	3	4	5				6															
	122	2			1	3	4	5		6															
	168	1				2			3			4													
	180					1				4	2	3													
Harrison.	3				3	2			1		5		4												
	20	3		4		5	6			2				1											
	22				1		3		4	2															
	26	1		3		4									2										
	36				1	4	2			5						3	6								
	41				6	5			4	2						1	3								
	42	2				1					4				3										
	63	3				1	4								2										
	73	3			1	5	6		5						4										
	87	1			4	3									2										
	90	1			2	4			3																
	95	1			4	2			3																
	102	1								2							3								
	252				2					3	1						4								
	275	1			2	3																			
	Author.	5		1	2	6			3						4										
Doddridge.	38					1												2							
	103									1								3	2						
	163	2			3										1										
	182				5	1	2	4									3								
	251	3			4	2				5	1					6									
	260				1				2		3					4									
Upshur.	12			6	1	2	3		4		5														
	34					1		4	3											2					
	114					4	5	2	1		3														
	207			5	3	1					2										4				
	238	2			4	3	5								1										
	241				2	3	4		1																
	249	2			5	1					4									3					
	Author.			4	2	3			1																
Lewis.	39	2			5	3									1						4				
	40	2			1	4			3																
	125				1	3			4												2				
	173				2	3		5	1												4				
	186				2	3		5													4	1			
	Author.				2	3		4	1																

Table 7—Northern Central Counties Continued.

COUNTY.	OBSERVER.	Elders[66]	Bitter Dock[167]	Teasle[70]	Sand-briar[132]	Broom Sedge[191]	Wild Carrot[59]	Yarrow[98]	Ox eye Daisy[99]	Cockle-bur[90]	Buck Plantain[159]	Field Garlic[178]	Wild Sw't Potato[127]	Burdock[104]	Briars[45]	Canada Thistle[108]	Spanish Needles[95]	Iron Weed[72]	Common Thistle[105]	Rag Weed[88]	Blue Devil[80]	White Devil[79]	Sorrel[168]	Dog Fennel[97]	Wild Flax[138]
Ritchie.	76					2	1				5		4												
	77	2													1										
	128	3			1	2																			
	231					3		4	1												2				
	245					3	4				1										2				
Wirt.	7					4			3	1				2			5								
	52	4	3			5			6				7		2						1				
	68		4			5			3	2			7				6				1				
	96				3			1					4								2				
	105				1								3								2				
	134					5		1	6		2										4		3		
	135				1	3					4										2				
	230					3		2	4												1				
	265				2	3			4												5				
	Author.				2	3			4		5		6		1						1				
Roane.	65					3		4						2			5	6			1				
	113					2							5				3	4			1				
	133																2				1				
	136		5		3	1							6					2			4				
	137		2			3		4					5				6	1							
	147		2		5	1							3								4				
	149		2		3	1															4				
	159				3	4					1										2				
	190					1			3												2				
	202		4		3	1			5												2				
	225					3		1	2		4										5				
	248					1		3													2				
	253					1		5					4				3				2				
Braxton.	108				6	4		3	5												1			2	
	146					3			1	5	4							2							
	236					6		1	5	2							3								4
	255				5	3		1			4														
	257					1											2							4	3
	266				1	2			3		4						5								

Table 8—Southern Central Counties.

COUNTY.	OBSERVER.	Ox-eye Daisy[99]	White Devil[79]	Broom Sedge[191]	Wild Carrot[59]	Common Thistle[105]	Cinquefoil[47]	Yarrow[98]	Cockle-bur[90]	Dog Fennel[97]	Spanish Needles[95]	Wing Stem[93]	Iron Weed[72]	Blue Devil[80]	Elders[66]	White Devil[79]	Sand briar[132]	Sorrel[168]	Buck Plantain[159]	Rag Weed[88]
Putnam.	32	1	2	3	4					5	6									
	116			3		1	2	4	5	6	7									
	212			2					3	1	4									
	227		1	5	4			6	2	3										
	Author	3	1	5					2			4								
Kanawha.	84			1									3	2						
	143	1		3				4	2											
	154	5		4			3								1	2				
	174													2		1				
	191			3					1		2									
	Author	1		5	3			2				4		6		7				
Clay.	254			3									2	1			4			
Nicholas.	189	2																1	3	
	Author	3						1				4					2			
Fayette.	106	3		1					6		4							5	2	
	130			1						2									3	
	132	2		3						4								1		
	Author	2		3								1								
Lincoln.	24		1	4					3					2						5

Table 9—Southern Boundary Counties.

COUNTY.	OBSERVER.	Ox-eye Daisy [99]	Yarrow [98]	Buck Plantain [159]	Broom Sedge [191]	Spanish Needles [95]	Sorrel [168]	Bitter Dock [167]	Cinquefoil [47]	Wild Carrot [59]	Sand briar [132]	Cockle-bur [90]	White Top [82]
Raleigh.	141	1	2	3	4			5					
	150	2	4	5	1	3		6					
	208				3	1	2	4					
Mercer.	81	5	1		4		3		2	6		7	
	97	4				2	1			3			
	129	3					1		2		4	5	
	264	2			4	5	1			3	6	7	
	270	2	3			4						1	
McDowell.	169	3			2	6				4		7	1

Table 10—Summary of the Worst Weeds, According to to the Tables.

The following weeds were *voted worst* the number of times set opposite their names:

Ox-eye Daisy[99]	55	Rag Weed[88]	5
Broom Sedge[191]	30	Burdock[104]	4
Wild Carrot[59]	22	Canada Thistle[103]	3
Blue Thistle[125]	19	Field Garlic[178]	3
Sand-briar[182]	15	Dog Fennel[97]	3
Elders[66]	14	Golden Rod[77]	3
Blue Devil[80]	14	Common Thistle[105]	3
Yarrow[98]	13	Wild Flax[138]	2
Sorrel[168]	12	Teasle[70]	2
Buck Plantain[159]	11	Wing Stem[93]	2
Bitter Dock[167]	9	Glenn Weed[15]	2
Briars[45]	8	Water Cress[11]	2
White Devil[79]	7	Wild Sweet Potato[127]	1
Spanish Needles[95]	5	Cinquefoil[47]	2
Cockle-bur[90]	5	Smart Weed[169]	2
White Top[82]	5	Iron Weed[72]	1

The following is a complete list of weeds reported as BAD, with the number of times each was so reported:

Ox-eye Daisy[99]	147	Common Thistle[105]	18
Broom Sedge[191]	145	White Devil[79]	14
Wild Carrot[59]	97	Field Garlic[178]	14
Yarrow[98]	94	Cinquefoil[47]	11
Buck Plantain[159]	73	Wild Flax[138]	9
Bitter Dock[167]	66	Glenn Weed[15]	8
Sand briar[182]	64	Wild Parsnip[62]	8
Spanish Needles[95]	61	Wing Stem[93]	7
Elders[66]	53	Naked Weed[112]	5
Cockle-bur[90]	53	Golden Rod[77]	5
Blue Devil[80]	46	Water Cress[11]	4
Blue Thistle[125]	45	Boar Thistle[105]	3
Wild Sweet Potato[127]	37	Corn Cockle[20]	2
Teasle[70]	33	Wild Lettuce[118]	2
Sorrel[168]	31	Beggar's Lice[41]	2
White Top[82]	28	Nigger Head[91]	2
Dog Fennel[97]	27	Jimson Weed[135]	2
Iron Weed[72]	25	Smart Weed[169]	2
Canada Thistle[103]	22	Wild Poppy[8]	1
Briars[45]	20	Sweet Clover[39]	1
Rag Weed[88]	20	Tall Rag Weed[89]	1
Burdock[104]	19	Morning Glory[186]	1

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Bulletin No. 23

WEST VIRGINIA

Agricultural Experiment Station

MORGANTOWN, W. VA.

YOUR WEEDS AND YOUR NEIGHBOR'S.

Part 3.

ILLUSTRATED DESCRIPTIVE LIST OF WEEDS.

MAY, 1892.

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1892.

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DESCRIPTIVE LIST

OF THE

WEEDS OF WEST VIRGINIA.

C. F. MILLSPAUGH, M. D.

BOTANIST.

In the following list of the individual weeds of this State, I have attempted to outline each species as fully as space would permit, and at the same time give under each what I could determine to be the best method of eradication, as well as some idea of its usefulness when any such quality is known.

I have grouped the plants in their natural order, i. e., all those of like characters together, giving in case of large families an illustration showing some of the characters of the family in general. In small families of usually well-known plants I have omitted the cuts. In the families, the parts of all plants mentioned will bear some likeness to the illustration; so that one not versed in plant names may, by examining the flower or fruit of a weed of which he desires to know the name, commence and compare the family characters with the same portions of the plant in hand until reaching one that agrees nearest; then read the descriptions until satisfied concerning the weed in question.

The letters (A) (B) or (P), following the common name or names mean respectively Annual, Biennial or Perennial. The figures in **black face type** refer to the same numbers in the list of observers on Pages 179 to 185 of Part 2, where the name is in common type, it means that the plant is a native of that region; when in SMALL CAPITALS, it is understood that the plant referred to is a foreign species becoming naturalized here. The names in italics are the

scientific names of the plants, by which they are known in all countries and languages.

The cuts illustrating the families of plants, as well as those of weeds; Nos. 39, 48, 56, 59, 63, 70, 77, 79, 85, 87, 91, 93, 97, 98, 99, 103, 105, 106, 107, 108, 109, 110, 112, 113, 114, 117, 119, 122, 124, 127, 138, 142, 163, 169, 171, 181, 184, 186, 187, 191 and 196 are from original drawings; the balance (thirteen) are adapted from the Reports of the Secretary of Agriculture.

BUTTERCUP FAMILY.

1. Tall Meadow Rue. (P.) (*Thalictrum polygamum, Muhl.*)

A common weed in damp meadows, where it grows to a height of 4 to 6 feet, and bears a showy, feathery cluster of greenish-white flowers, in July. Should the land where this weed grows be desired for cultivation, the underdrainage necessary to reclaim it would doubtless kill out the weed.

2. Small-flowered Buttercup. (B.) (*Ranunculus abortivus, L.*)

A frequent weed in and about moist yards and meadows, where it appears as a low, juicy-stemmed, branching herb, with quite small greenish-yellow flowers, and little bur like clusters of seed. This is one of the minor weeds that yield readily to the hoe or drainage; it is, however, a profuse seeder, and should it become obnoxious in any given locality, the land should be drained and cultivated. The Buttercups are said to be frequently the cause of "slobbering" of cattle, and should be carefully weeded out of pasture lands.

3. Tall, or Acrid Buttercup. (P.) (*Ranunculus acris, L.*)

This is the common tall buttercup in most localities, which bears the well known yellow saucer-like blossoms so well loved by children. It is one of the hardy European immigrants, and the most acrid species of its class in this country, blistering the mouths of cattle eating of it. The blistering property is, however, lost in drying and therefore harmless in well cured hay. This buttercup, like the next, grows mostly in moist meadows and along ditches, and may be removed when too prevalent by underdrainage or tillage.

4. Creeping Buttercup. (P.) (*Ranunculus septentrionalis, Poir.*)

Similar in appearance and place of growth as the last plant,

but weak and prostrate, with running stems, and larger flowers. To be treated like the last.

5. **Rattle-root. Rattle-weed. Spuaw-root. Black Cohosh. Black Snake-root.** (P.) (*Cimicifuga racemosa* (*L.*), *Nutt.*)

This well known woodland plant often becomes a troublesome weed in newly cleared lands, and in neglected fields bordering woodlands It is readily recognized by its long wand-like stem, terminated by a spike of fuzzy white flowers, becoming later in the season, a rattling mass of papery pods. This weed will not withstand the usual tillage of the soil, nor will it infest our meadows and pastures.

The root is a well known family medicine, being used as a tonic (213), blood purifier (50.214), and stomachic (113). It is used in conjunction with sumach for liver troubles (137), and is said to prove a good purgative for animals (35) and a general alterative for hide-bound horses (214). Its excellence in some forms of rheumatism (73.121.190) is well understood by the medical profession. The use of a syrup of the root for coughs (123) and sore throat (236), and a decoction for colds and fevers (236, 267, 147, 244, 96, 216, 213) seems to be quite general in this State. The root has also been recommended for small pox (101), though it is doubtful if it would be relied upon when other and better known remedies were obtainable.

Custard Apple Family.

6. **Papaw.** (P.) (*Asimina triloba* (*L.*,) *Dunal.*)

This well known shrub, or small tree, with edible fruit, often becomes a veritable nuisance in pasture lots and meadows, though in some localities its sprouting is not so profuse as in others. Like the sumach, it can only be eradicated by thorough grubbing.

Barberry Family.

7. **May-apple. Mandrake.** (P.) (*Podophyllum peltatum*, *L.*)

No description is needed of this common plant which can be properly called a weed only in some localities. In many damp or woodland meadows it often, however, grows so profuse as to greatly contract the grass area. The use of the hoe, will kill it out in a few seasons.

The medical action of the root seems to be expended almost entirely upon the alimentary tract ; it is, therefore, used for general torpidity of the liver (21, 78, 204), and as a purgative (35, 139, 213, 225). The extensive use of the root as a component of cathartic pills, causes it to be dug for profit at many points in the State.

POPPY  FAMILY.

8. **Field Poppy. Corn Poppy.** (A.) (*Papaver dubium, L.*)

This pretty red poppy, which bears a general resemblance to the poppies of the gardens, and is illustrated above; is rapidly spreading in Jefferson, Berkeley (**117**), and Morgan counties, where at least, it threatens to become a troublesome weed. The plants should be pulled up before they ripen their immense number of seeds, and burned with other trash.

9. **Horn Poppy.** (A.) (*Glaucium luteum, Scop.*)

This peculiar plant, with saffron-colored milky juice, whitish-green stem and leaves, yellow flowers, and stem prickly below near the ground; has been sent in to me as a weed likely to become troublesome in Monongalia (10) and Harrison counties. It should, however, yield readily if the plants are treated as mentioned under the preceding species.

MUSTARD  FAMILY.

10. **Horseradish.** (P.) (*Nasturtium Armoracia* (*L.*) *Fries.*)

In some localities this well known garden plant escapes and becomes a very troublesome weed, taking possession of large tracts and proving very difficult to eradicate (237). Thorough turning up of the roots yearly, and removing them from the spot, is the best measure to use against this growth.

The roots, gathered in spring, grated, and placed in vinegar

for use on the table as a sauce with meats, forms an excellent appetizer, as well as acting as an antiscorbutic. A poultice of the fresh leaves is considered a good remedy for some types of headache, if bound about the forehead (249).

11. **WILD MUSTARD. CHARLOCK. "WATER CRESS."** (A.) *Brassica arvensis* (*L*) *B. S. P.*

This tall mustard-like plant with yellow blossoms has become a pest in the wheat growing districts of the valley counties. As it is a profuse seeder, and the seeds known to retain their vitality for long periods, the best method of ridding the farm of this troublesome plant is to carefully cut and burn all when the blossoms first appear. Sheep are fond of the weed (35), but it is best not to trust them to eradicate it.

12. **MUSTARD. BLACK MUSTARD.** (A.) *Brassica nigra* (*L.*) *Koch.*

This mustard becomes at times quite troublesome in fields and along roadsides. It grows more slender and less branching than the last, and never as tall. It should be treated the same as the Wild Mustard.

13. **SHEPHERD'S PURSE.** (A) *Bursa Pastoris* (*L*).

A small weed with the lower leaves much like those of the Dandelion both in shape and arrangement around the base of the stem, and bearing minute white flowers, and later a profusion of flat, heart-shaped seed pods. This weed, though most frequent along roadsides, often becomes troublesome in gardens and fields. Thorough cultivation and enrichment of the soil will, however, tend to suppress it.

14. **Peppergrass,** (A.) *Lepidium Virginicum, L.*

A small weed, similar in appearance to the last, but with roundish pods notched at the top; most frequent in door-yards and along roadsides, though often found largely in cultivated fields. Treat as for No. 13.

15. **ENGLISH PEPPERGRASS. "GLENN-WEED." "GLENN-PEPPER." "CROWD-WEED."** (A.) *Lepidium campestre,* (*L.*) *RBr.*

Similar to the last, but profusely branched, and often with many stems from the root; pods egg-shaped and winged; and the leaves (which fall early) arrow-shaped. This European immigrant is rapidly becoming one of the worst pests in the Valley Counties. It is a most profuse seed-bearer, often producing as high as 40.323 to the single plant, by actual count. I have seen fields of wheat so completely filled with this weed that the stand was far greater than that of the grain. The amount of seeding-in by such a crop is almost beyond imagination. "It actually crowds out the wheat" (47) in some cases. "This weed fully destroyed any chance for a crop

of wheat in a field near Hedges, the stand was afterward plowed under" (117). "It is the worst weed in this section, being known here as the Glenn-weed. (So called, because it was first noticed on a farm owned by people of that name. It is believed to have been brought there in oat seed from Maryland). It is more numerous this year than I have ever seen it before, several crops of wheat in this neighborhood being almost ruined by it" (78).

This weed will prove as hard to eradicate as any that I know of, on account of our inability to plow up the newly sprouted seeds, as it is usually winter wheat that suffers from it most. I can offer no method at present that could be efficaciously applied, except summer fallowing as directed in Part 4 of this Bulletin. Much can be done toward its eradication, however, in corn lands where the necessary cultivation will tend to greatly lessen the number of plants allowed to go to seed. In other cases, a careful preparation of the land, and laying it in good clean meadow is the only way I can see at present of decreasing this pest.

The great similarity of the seed in size and shape to that of Red Clover; and the fact that the plant seeds at the same period, should warn farmers generally not to grow clover for seed where the weed is present; and also that it would be dangerous to sow clover seed known to have been produced in a regiou where this weed grows. To those who examine their seed before planting, with a magnifying glass, to detect impurities, those of the "Glenn-weed" will appear covered with a fine transparent mealiness, not smooth as if varnished like those of the clover.

16. **WILD RADISH.** (A.) *Raphanus Raphanistrum, L.*

This wild species, which bears a general resemblance to the cultivated form, bids fair to become quite troublesome in the fields of some sections of the State. It may be recognized by its yellow flowers turning purplish veined, or white as they age; and its necklace-form pods.

It is best to pull up, or cut and burn, this weed during its stage of flowering to prevent the ripening and distribution of its numerous seeds.

VIOLET FAMILY.

17. **Violet.** (P.) *Viola cucullata, Ait.*

This common and pretty form of the blue violet has been complained of in some localities as a bad weed in meadows. As it tends to spread quite profusely wherever it gains a footing. I would suggest the digging up of the plant wherever found, before it gets beyond this method of treatment. Of course the plant will not persist in cultivated soils.

18. **Field Tri-colored Violet.** (P.) *Viola tenella, Muhl.*

This dainty little plant becomes quite a weed in some meadows, and should then receive the same treatment as the previous species.

PINK  FAMILY.

19. SOAP-WORT. BOUNCING BET. (P.) *Saponaria officinalis, L.*

There are probably few weeds in this State that are at present spreading more profusely than this. It may be described as a coarse, conspicuous plant, about three feet high growing in clumps, with large pink-like, rose-colored, often double flowers, the odor of which if much inhaled will cause susceptable persons to vomit. The root yields a mucilaginous juice that will form a lather with water, like soap; hence the name.

This weed seeks uncultivated soils like railroad embankments and roadsides. In Jefferson, Berkeley and Morgan counties it is found in great quantities along the B. & O. R. R. It spreads mostly by root. Though this plant will probably never extend to cultivated fields, or to pasture lands, its appearance gives any farm roadside a shiftless look, it should, therefore, be grubbed out and thrown in the compost heap where it will be of some use. Two seasons of grubbing will kill it out.

20. COCKLE. CORN COCKLE. (A) *Lychnis Githago, (L.) Lam.*

This common weed of wheat fields, with its rose-colored flowers, is too well known to need description. Though it may be carefully rooted up by the farmer, still it maintains its place year after year in wheat sections, on account of the difficulty of obtaining cockle-free wheat for sowing. The presence of the roundish black seeds of this weed in wheat is readily detected, but their separation from the grain is vastly more difficult. These seeds also injure the quality of the manufactured flour. The only method by which wheat can be produced free from the seeds of this pernicious weed, is to sow only cockle-free seed wheat, and to carefully pull the cockle plants from the field when they are in bloom.

21. CHICKWEED. MOUSE-EAR CHICKWEED. (P.) *Cerastium vulgatum, L.*

This spreading, clammy-hairy, little plant, with leaves something like mouse's ears, growing in tufted masses in fields and gardens, and along roadsides; threatening to become a nuisance in many localities. In Mineral county, the seed of this plant is supposed to have been imported from Europe with that of the Turnip (46.) In

Wood county, it has become in places a quite troublesome weed 194. The only means of getting rid of the plant is thorough cultivation, where possible, to prevent the weed from maturing its seed.

This plant is said to cure diarrhoea when taken in tea, by coating the bowels; being especially useful when the passages are bloody (35.)

22. **Chickweed.** (A.) *Stellaria media, (L.) Smith.*

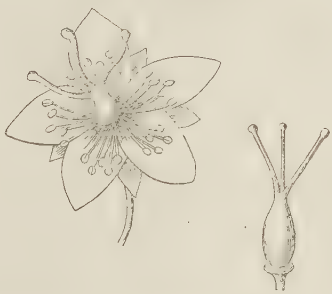
This probably better known chickweed differs from the last in its more star-shaped white flowers, its larger growth and leaves, and its tendency to remain green and flower almost throughout the winter. It is most common about dwellings, and in moist fields, whence it is often gathered by housewives as a food for caged birds. The plant frequently becomes plentiful enough to be very troublesome, and has been known to grow so profusely as to crowd out other vegetation. This weed yields quite readily, however, to careful cultivation.

23. **PURSLANE. PUSSLEY.** (A.) *Portulaca oleracea, L.*

"Meaner than pussley" has become in some localities a synonym of persistent and obtrusive offensiveness; an expression originating from the resistance of this weed to succumb to ordinary hoeing, especially in damp weather. Purslane is well known by its fleshy leaves and stem; its spreading, clinging, prostrate growth; and its great vitality. Thorough hoeing, or careful cultivating, in a dry season, before the seed are matured will kill it out; especially, however, if some care is used to render the plants helpless by turning them over upon their backs as one would turtles.

This weed was once considered a good pot-herb, but of later years it has been supplanted by much more esculent vegetables.

ST. JOHN'S WORT FAMILY.



24. **St. John's-wort. St. John.** (P.) *Hypericum perforatum, L.*

An erect, woody herb, 1 to 2-feet high, branching, with numerous opposite leaves dotted with minute black spots, rooting offsets from the base of the stem, and bearing many clusters of yellow flowers like those in the cut above. This intruder often becomes a very troublesome weed in pastures, and should be pulled up by every neat farmer as soon as discovered. In an early day it was

supposed to be the cause of a disease then prevalent among cattle, characterized by ulcerous sores appearing upon different parts of the animal, and affecting white cows, and horses with white feet and noses especially; however, as this disease has disappeared, and the St. John's-wort has not, it must have been due to some other cause; probably an epidemic.

The plant has been recommended in fresh decoction, for coughs and hoarseness (**188**); and being somewhat resinuous in its nature it has been used in some forms of bowel troubles. One of the later and more scientific uses of this plant, in alcoholic tincture deserves special mention: In this use it has been termed "The Arnica of the Nerves," being found to be an excellent internal remedy, in two drop doses frequently administered, for wounds or bruises where the nerves or spine has been injured. Most gratifying results have followed its administration, even in bad cases of lock-jaw.

25. **Shrubby St. John's-wort. Broom-brush.** (P.) *Hypericum proliferum, L.*

In glady regions this profusely branched, shrubby form of St. John's-wort is often a decided pest in meadows and pasture lands. This plant may be eradicated by first underdraining the land, a process that the presence of this plant shows the need of. The plants now grubbed out will never sprout up again.

MALLOW FAMILY.

26. **Common Mallow. Cheeses.** (P.) *Malva rotundifolia, L.*

This is a common garden weed, with round scolloped-edged leaves, and small yellowish-white flowers; the seeds form a flattened globular mass set within a hull like that of a strawberry, and when green are mucilaginous, and are often gathered and eaten by children under the name of "cheeses." This weed often gives a great deal of trouble to the gardner especially, and should be pulled up and thrown on the compost heap before the seeds ripen.

The seeds are often used in domestic practice to make a demulcent drink, in place of slippery elm water; and the whole plant as a poultice for inflamations.

27. **Spiny Sida.** (A.) *Sida spinosa, L.*

This native of India is becoming but too thrifty in waste and

cultivated lands along our greater water courses. It grows more upright than No. 26, the leaves are elongated egg-shaped, and saw-toothed on the edges: the flowers are small, greenish-yellow and resemble a single hollyhock blossom in shape; the fruit is composed of five small, two-horned pods all enclosed in a hull. The name denotes a character that the plant does not possess, as it has no spines but only a little wart-like process at the base of each leaf stem.

This weed is very aggressive and utterly useless, and should be pulled up before seeding, and thrown with its kindred into the compost heap.

28. INDIAN MALLOW VELVET-LEAF. (A.) *Abutilon Avicennae, Gaertn.*

In some sections of the State, the tall stems and large velvety, heart-shaped, pointed leaves of this Indian plant are very conspicuous indeed, especially in corn and potato fields. This weed is more frequently allowed to grow and mature its seed at will than well befits the thrifty farmer. An annual so easily subdued by cutting out when in flower, should not be seen upon any man's lands. The peculiar inverted-bell shaped fruit shown in our illustration will always indentify this species.

29. FLOWER-OF-AN-HOUR. BLADDER KETMIA. (A.) *Hibiscus trionum, L.*

This last weed of the mallows has a deeply rooted tendency to infest our gardens and cultivated fields, where its floral life is short, and its seeds are rapidly matured. The weed may be readily recognized by the great resemblance of its flowers to those of the Rose of Sharon of our door yards—they are, however, yellow with a purple eye, instead of rose colored as in that shrub. The plant grows about one to two feet high, and bears three-parted leaves of which the middle part is the longest. As this European plant is quite ornamental, try and induce the children of your household to pull up all they can find and put them in vases to ornament the house; this will in time rid you of the weed, if they are praised delicately for their pretty boquets.

GERANIUM FAMILY.

30. **Wild Cranesbill.** (A.) *Geranium Carolinianum, L.*

In several sections of the State this pretty little wild flower

has become a great nuisance, both in cultivated fields and in meadows, where it spreads profusely, covering the entire surface in its chosen locality and choking out all other vegetation (98). "It is considered a bad weed in Cabell county." (194). I have noticed in many places in Monongalia, large patches of the dense growth of this species, grearly contracting the area of grass in meadows. The weed may be recognized by its pink flowers resembling that depicted above, by its rose-geranium-like leaves, and its peculiar seed pods also illustrated here. This seed pod is so formed that in bursting the seeds are thrown quite a distance compared with the size of the plant, therefore grub it out before the seeds are ripe, and throw it into the compost heap, and watch the spots the next season prepared to treat what appears the same way.

The root is drastic, and is often used in decoction for bowel troubles. (202).

31. Yellow Sheep Sorrel. (A.) *Oxalis corniculata, L., var. stricta (L), Sav.*

A small, appearently weak weed with sour clover-like leaves, and small yellow flowers; growing in fields, meadows, pastures, gardens, along roads, and in waste places. That this is a bad weed may be seen by the following analysis by our Station Chemist, which shows that one dry ton of the plant robs the soil of the following amount plant food:

37.74	lbs. Nitrogen,	value at	19 cents	7.17
55.88	lbs. Potash,	value at	5 cents	2.79
11.18	lbs. Phos. acid,	value at	8 cents	.89
				$10.85

Where this weed is prevalent, thorough cultivation, and dressing with plaster for several seasons, will kill it out.

QUASSIA FAMILY.

This family is represented in this country only by :

32. The Tree of Heaven. Chinese Sumach. (*P*) *Ailanthus glandulosus, Desf.*

A large tree, imported from China years ago with the idea that its presence would absorb all malarial miasm, and thus render its neighborhood free from fevers of that type. In its early growth it resembles the common sumach, when large, the Black Walnut. The fruit is an immence pendant mass of winged seeds something like those of the Maple, and like them capable of sailing with the wind.

However it may be concerning its quality of absorbing malarial poison, the female tree is certainly becoming a serious pest in many parts of the State, and should be destroyed, the pure males alone being allowed to grow for shade or ornament in towns. There is how-

ever a great objection even here, as these trees emit when in flower an odor that is painfully obnoxious to many people. This tree has spread so badly from the seed in Lewis, Jefferson, Marion, Monroe, Gilmer, Kanawha, Jackson, Monongalia, and other counties near the larger towns, as to warn the people of the necessity of destroying at once all fruit bearing specimens of the species. In many places clumps of seedlings have become as dense as sumach tangles, and should be treated the same way, by grubbing them out as soon as possible.

Several cases of poisoning from this species are on record, from children eating the flowers; the symptoms arising being similar to those of a severe attack of catarrhal croup, but far more serious.

THE VINE FAMILY.

33. **Virginia Creeper. American Ivy.** (P.) *Vitis quinquefolia (L), Lam.*

This vine with its pointed five-divided leaves, like the outspread fingers of a hand; and which turns such a bright crimson color in autumn; is too well known to need a farther description. There is nevertheless considerable misunderstanding in regard to it, many mistaking it for the poison vine, or poison ivy, which however has only three divisions to its leaves which are often wavy or notched on the margin something like the white oak, whence the name "poison oak" so often applied. (See illustration below.) Grubbing is the only method that will remove the plant from places where it is judged to be a weed.

CASHEW FAMILY.

Poison Ivy.

34. **Sumach. Shumake.** P. *Rhus glabra, L., and typhina, L.*

On sandy or gravelly hillsides and like situations the Sumach is a very troublesome shrub, often causing extreme labor on the part of the cultivator to keep it in any kind of subjection; it being one of those weeds that seems to thrive upon opposition, and grow the thriftier for being disturbed. Grubbing and burning the roots so torn up is the only method that will tend to result in its erradication and this only if persisted in.

35. **Dwarf Sumach.** P. *Rhus copallina, L.*

The winged leaf-stems of this species render it the most ornamental of our forms, but as we are not now dealing with the ornamental, this point will only serve in distinguishing this species from the others. Dwarf sumach habits the poorer soils of exposed hill-sides and knolls, where it proves as hard to eliminate as the two previous species. The same treatment must therefore be applied to it.

36 **Poison Ivy. Poison-Vine. Poison Oak.** (P) *Rhus radicans, L.*

In some portions of the State especially in the northern counties there is no more obnoxious weed than this miserable vine. Apart from its liability to poison anyone passing near it on a damp day or especially one trying to dig it out, its persistence is similar to that of the other and more shrubby forms. Should this vine need any description whatever for the reader to know it, the cut at the beginning of this family of plants will probably be all that is necessary; it represents the leaves of the "poison oak" variety, often however they are entire on the margin, not even wavy. There are over two acres on University Campus here, one dense mass of the vine, and along the Monongahela River below stands a fence a quarter mile long, every post of which looks like a picturesque pollard willow in winter from the dense masses of this vine that cover them. So profuse is the growth in some places in the State, that no attempt whatever is made to reclaim the land. In Hampshire also "it is a very troublesome weed" (**119**.)

The only method of successful action against the vine is thorough grubbing during a very dry season, though people susceptible to the poison should not attempt to work at it.

Single drop doses of an alcoholic tincture of the whole plant, morning and night twice a week, is often curative of certain kinds of rheumatism, especially muscular forms that are worse in damp weather, and where there is a deal of stiffness on first beginning to move, that gets better as the muscles are worked a little. The best application to parts effected by the vine is some alkaline wash like a solution of common washing soda. A wash made by boiling elder leaves in buttermilk is recommended. Poultices of the fresh leaves of Vervain (weed No. 142), often prove a great relief. "The milk of Wild Cotton (weed No. 119) applied to the parts affected will cure nearly every time" (**55**). See also remarks under weed No. (130.).

PEA & BEAN FAMILY.

This family includes all those plants that have a butterfly-like flower similar to those of the Pea, Bean, Redbud, Locust, Peanut, etc., etc.

37. **Rabbit-foot Clover.** (A.) *Trifolium arvense, L.*
An erect hairy, branching, clover; with soft oblong hairy heads, bearing some resemblance to a rabbit's paw. A native of Europe, now becoming quite thoroughly naturalized in this country. Its presence is such a plain advertisement of thin soil, and neglected agriculture, that all who have it upon their lands should adopt methods of improvemet by higher cultivation and more thorough fertilzation, that will supplant it with more valuable growths.

38. **Yellow or Hop Clover.** (A.) *Trifolium agrarium, L.*
This little weed creeping surely and persistently westward from the Atlantic seaboard is now found quite plentifully in the valley counties. It may be readily recognized from its small dense, oblong heads of yellow blossoms, low habit, and general clover-like appearance. Lands infested with this worthless weed and its companions cinquefoil and red sorrel should, receive thorough cultivation following a good plaster dressing.

39. **White Melilot. Sweet Clover. Bokhara Clover.** (B?) *Melilotus alba, L.*
This tall weed with slender stems 4 to 6 ft. long tipped with slender spikes of small white blossoms, and sparse sweet-scented clover-like leaves, is valued in some sctions as a forage plant when the cattle have been trained to eat of it, and as such has been somewhat cultivated in this country. From these points of cultivation it has escaped and become a coarse weed, which cattle here utterly refuse to eat of except when it is cured or young and very tender. The plant grows with us mostly along ditches and roadsides and in waste places in the valley counties, and near the larger towns in other portions of the State; where, though sweet-scented and and graceful, it is unsightly and uselesss. Though having reason to doubt its value here as a fodder, I have none as to its classification as a weed.

Sweet Clover.

The cultivated plant, according to the analysis of the Massachussetts Station gives about the following

food constituents: Protein, 2.09; nitrogen free extract 3.09; crude fibre 3.06; ether extract (fat, etc.) 0 4; thus giving a wide nutritive ratio of 1:4 7.

The best method of utilizing this weed is to grub it out while in flower and compost it. Treated thus, the following table will show for it a higher value as a manurial substance than as a food:

	Mass. Analysis.	W. Va. Analysis.
Nitrogen,	1.77	2.40
Potash,	1.67	1.95
Phosphoric Acid,	.43	.50

The Massachussetts analysis thus gives it a value of $9.15 per dry ton and ours $10.85; its average value is therefore $10.

40. **Yellow Locust.** (*P.*) *Robinia pseudacacia, L.*

This common tree whose north-eastern limit is within the boundaries of this State, often proves a troublesome weed by its persistence in sprouting from the root or stump, as well as its capacity and frequency of seeding in on lawns and meadow lands, as well as in pastures. The only method of subduing it, is to pull out the stumps with their major roots, and to grub out carefully and thoroughly all seedlings as they appear.

This tree reaches its highest development on the western slopes of the mountains of this State. Its timber is well known as very durable underground, being on this account extensively used for fence posts and other partly buried supports. The wood is heavy, hard and strong, close-grained, and compact. It ranks third in strength, nineteenth in elasticity, and one hundred and thirty-seventh in fuel value among over three hundred species of American woods.

This tree is just now undergoning a crisis in its existence in this State, that threatens to end very disastrously: for not only has the common borer (*Clytus Robiniæ*) been very industrious, but full forty other insects have added their work to its destructive operations. Our Entomologist says of this trouble:

"Returning to the Station on August 7th, after an absence of about two months, I observed the locust trees all along the Baltimore & Ohio R. R., between Central Station and Morgantown peculiarly affected. The trees everywhere in the forest and field having a scorched and dead appearance."

"The landscape thus marred by the dead appearance of this, one of our most valuable as well as beautiful forest and shade trees, attracted the attention of every one, and excited their wonder and curiosity as to the cause of the trouble."

"The present trouble was found to be caused by insects; and the region thus affected so far as I have since observed extends through Doddridge, Harrison and Preston counties, from Grafton westward to near the Wetzel county line, from Fairmont through Monongalia county to the Pennsylvania line, and from Piedmont southward through Tucker, Randolph Upshur and Lewis counties. The

trees were unaffected through Ritchie and Wood counties, and along the Ohio River as far as was observed, the leaves being fresh and green at the time they seemed to be dying in the infested districts mentioned. This dead and scorched appearance of the locust trees at a time of year when they are noted for their beautiful green foliage was, as far as can at present be learend, first noticed in Harrison county about the year 1885, when a few scattering trees were observed to turn brown. The number of trees thus affected rapidly increased each year until every tree, bush, and sprout of this species looked as if it had been killed by fire. This trouble continued to spread until at present at least one-fifth of the State is affected."

While over forty species of insects were found to be feeding on different parts of the affected trees, one species, the Locust Hispa, appeared to be the principal cause of the trouble.

Such widespread affection of this valuable timber is very deplorable, and unless checked by some one of Nature's remedies will cause great loss to the State. This seems possible from our observations last season.

41. **Beggar's Lice. Beggar's Ticks. Stick-Tights.** (P) *Desmodium sp.*

There are a large number of species of this genus of plants whose general characters are similar. They are known by their three-foliate leaves, long flower stems, small scattering pea-like pink blossoms, and adhesive pods arranged like a chain or necklace. These latter separate into little triangular or roundish flat "seeds" that stick to and mat the hair or fleece of animals. Some of the species are found in all weedy places, open woods or fields, and are the particular bane of Shepherds, as they decrease the value of wool and cause torment to the sheep themselves by their irritation. The practice of beating down these weeds before the fruits form is often resorted to, but the best measure would be to hack them of with the hoe, in open woods, or cut them with other weeds when growing along ditches, fence rows and like places and cart them to the compost heap. In large, weedy fields such as I have often seen in the State where this weed abounds in great quantities, treatment should be adopted according to Part 4 of this bulletin. One of the species (Desmodium rotundifolium, L) is called "Hive Vine" in some sections, where it is used in decoction for hives (220).

42. **Bush Clover. Violet Clover.** (P.) *Lespedeza violacea, Pursh.*

A low bushy clover-like plant with small violet pea-like blossoms, closely arranged on the long slender tips of the stems. In some dry fields, this plant becomes as prevalent as cinque foil. Cattle eat of it when young but refuse it entirely later in the season. Its eradication should be undertaken through a thorough renewal of the field with proper cultivation, plaster dressing and fertilization.

42a. **Japan Clover.** (P). *Lespedeza striata, L.*

A low herb with small trifoliate leaves, and very small flowers, producing little flatish one-seeded pods. The seeds of this plant were accidentally brought into South Carolina about the year 1849 from China; from whence it has spread quite rapidly over the South and has been tenaciously holding its own wherever introduced. In the South, it is considered a very valuable forage plant which idea is fully sustained by chemical analysis. As a weed, the plant often crowds out our best grasses, and as it freely produces quantities of small seeds, it proves quite hard to exterminate. Its use as a forage plant seems to be more or less like that of the Bokhara Clover, as cattle have to be starved in order to take lessons in eating of it. Prof. Gulley of Mississippi says: "For the South, Japan Clover is, without exception, the most valuable plant that grows, after once started it grows spontaneously, except on lime land. It keeps hills from washing, even coming in to fill the washes. It can be killed by plowing for one year On good land, it grows from 12 to 24 inches high, cuts a good crop of hay, equal to first class timothy. It will grow when Blue Grass and Clovers fail entirely. It stands dry weather admirably, and on some soils will even choke out Bermuda Grass."

In contradistinction to this, Mr. Henry Stewart, in the "Country Gentleman" for January, 1886, says: "I assert emphatically that unless cattle and pigs are starved to it they will not eat the Japan Clover or any kind of Lespedeza. This statement is given to prevent your readers from being fooled into buying the seed and trying to grow it in any place north of Virginia."

Mr. J. W. Miller, of Barboursville, this State says: "I consider the Japan Clover one of the most dangerous weeds we have to contend with in this part of the State. It first made its appearance down the Sandy river, and then came down the Guyandotte. It came from the South I know parties here who paid at the rate of $40 per bushel for the seed, when it was taking all the fields in this section as a weed. It grows on any kind of ground, poor south hillsides are adapted to it, and it will grow in the woods; but the trouble is, when it gets among our tame grasses, it will destroy them. It comes up from the seed every year about May 1st and grows 8 to 10 inches tall and is killed by the first frost. After this, the ground looks as bare as an old pennyroyal field, stock will now eat it but it is too short lived to be of any value. I think should it get scattered over all our State, it will be a great curse to the farmer, as it has killed out both Orchard and English Blue Grass in my pastures. By all means warn our farmers against buying this seed."

This plant has become a weed in this State almost throughout the southern section. It may be eradicated by thorough cultivation and plaster dressings, as suggested by the words of Prof. Gulley as quoted above.

43. **Wild Senna.** (P.) *Cassia Marliandica, L.*

This bushy herb with its showy yellow flowers and locust-like

leaves and pods, has become a troublesome weed in many sections of the State; especially, however, in Fayette, Summers, Gilmer, Kanawha, Mason, Harrison, Webster (246), Monongalia, and Marion, near Gray's flat (259). It should be grubbed out wherever found, especially as its agressiveness is not yet thoroughly known.

The dried leaves act much the same as the Senna of commerce in three times the dose: its action, however, often causes severe griping.

44. **Honey Locust. Black Locust. Three-thorned Accacia.** (P.) *Gleditschia triacanthos, L.*

This well known tree extends in this State to the higher Alleghanies, where on lawns as well as in parks, fields and meadows it causes trouble, much as does the Yellow Locust by its sprouting and profuse seeding in; and should receive even more thorough attention. The thorns are very strong, and when scattered about after being broken off by the wind, often penetrate the feet of cattle causing severe wounds.

This tree properly planted and pruned makes a completely impervious hedge. The wood is heavy, strong and quite compact, and although it is somewhat coarse-grained it takes a very high polish. It is, like the Yellow Locust, very durable under ground, and is used in a similar manner; it is, however, eighty-third in order of strength, sixty-sixth in order of elasticity, and one hundred and ninetieth in order of relative fuel value, among about 400 American woods.

ROSE  FAMILY.

To this family belong all of those plants resembling in their flowers the well known cherry, peach, thorn, apple, rose and strawberry. It is one of the largest families of plants represented in North America.

45. **Briars. Blackberry.** (P.) *Rubus villosus, Ait.*

This well known plant, particularly obnoxious from its tendency to take absolute possession of old fields, needs no description here, as it is already too prominent in the minds of our farmers. The berries produced, as well as the vines, vary greatly in size, thorniness and general appearance according to the soil and locality in which they grow. The best method of subduing this pest is to

cut over the land thoroughly in July and September for three years, casting the crop gathered into the compost heap, where, when properly rotted, it should be worth the labor as a manure.

When with all the labor of gathering, the berries bring but four or six cents per gallon as usual in our markets, the bushes would be worth more as compost than their yield as a table fruit.

The root has long been known in domestic practice as an astringent, and as such is used in decoction for summer complaint (249); diarrhoea (239); and dysmennorrhoea (154). A sort of brandy made from the juice of the fruit, and preserves of the same, are also slightly astringent.

46. **Dewberry, Running Briars.** (P.) *Rubus Canadensis, L.*

This prostrate form of the blackberry is a very prominent weed in this State, and should meet with the same treatment as the last. The berries are usually larger and sweeter, as well as earlier, than the high bush forms.

The famous Leucretia Dewberry originated in this State near Beverly, Randolph county.

47. **Cinquefoil. "Sinkfield."** (P.) *Potentilla Canadensis, L.*

This too well known little runner that is often complained against as "taking" whole fields running out the good grass and proving altogether obnoxious, needs no description except may be to the scientific farmer who seldom sees it upon his own lands. Large quantities of this plant indicate two things; a poor thin soil or thriftless farming. Plentiful use of good, well-rotted, stable manure with lime or plaster, and one thorough cultivation will rid land so treated of this detestable pest. Old pastures run to Cinquefoil and Sorrel should be treated in this manner and sown with good, clean, pasture-grass seed.

48. **Stick Seed. Beggar's Ticks.** (P.) *Agrimonia Eupatoria, L.*


Agrimonia.

This little plant with light green leaves, similar to those of the strawberry and rose, and a long tip of small yellow flowers resulting in numerous little greenish, pear-shaped, prickly-hooked fruits, so detrimental to sheep and wool; is one of the worst of pests to the shepherd. It grows in damp, shady places, along ditches and runs and in open woods, from whence it should be carefully cut with other trash twice a year until subdued.

49. **Stick Seed. Beggar's Lice.** (P.) *Agrimonia parviflora, L.*

This plant which is a twin of the preceding species, only differs from it to the eye of the general observer in its more numerous leaflets and smaller flowers and fruits. The fruits being fully as well armed with prickles as the last, the plant should receive the same treatment as a weed as its predecessor.

50. **Wild Rose. Swamp Rose.** (P). *Rosa Carolina, L.*

This beautiful swamp brier with its clusters of deep pink single roses terminating the branches, grows from 3 to 5 feet high, and often forms almost impenetrable thickets on low lands and in wet meadows. Such lands, if needed for cultivation, require thorough underdrainage for one year before removing their weeds with the mattock and scythe. One careful going over will then reclaim them from this character of growth, especially if the treatment for low fields—recommended in Part 4—be faithfully followed.

51. **Sweet Brier. Eglantine.** (P.) *Rosa rubiginosa, L.*

This plant introduced from Europe threatens some parts of the State with one of the most formidable briers capable of growing in this section. The bush grows densely and lustily, and its yellow-green stems are armed with strong curving prickles; its leaves are resinous beneath and aromatic; and its flowers and fruits very showy. This species has become quite noticeable in parts of Nicholas, Randolph, Greenbrier, Summers, and Monroe counties, and should be carefully grubbed out wherever seen.

GOOSEBERRY AND CURRANT FAMILY.

52. **Wild Hydrangea.** (P.) *Hydrangea arborescens, L.*

This bush bears some resemblance in its blossoms to the common elder, but on close inspection will be found to differ from it widely, having broadly ovate leaves, and larger white flowers scattered around the margin of the clusters of small ones. The shrub grows from 4 to 6 feet high, and flourishes in damp spots near springs, runs or rivers, and sometimes in damp meadow lands where it may be killed out by grubbing and watchfullness.

The stems were used in an early day by housewives for weaving "quills"; and a decoction of the young twigs, flowers, and leaves, was considered valuable in reducing the pain caused by the passage of gravel, especially in the earlier stages of the disease.

MELASTOMA FAMILY.

53. **Meadow Beauty. Deer Grass.** (P.) *Rhexia Virginica, L.*

In damp meadows about our river bottoms and like situations, this pretty flowered weed is often very profuse. It grows erect, about 4 to 8 inches high, and bears little clusters of large purplish-pink flowers with large yellow anthers, from each of the upper leaf axils. The stem is square and winged along the angles.

This weed, like all others found associated with it will only yield to cultivation after the grounds upon which they grow are well under-drained.

LOOSESTRIFE FAMILY.

54. **"Tar Weed."** (A.) *Cuphaea petiolata*, (*L.*) *Koehne.*

This persistent little weed with its purplish stems and flowers, is considered a nuisance in many parts of the State (**36, 73. 111, 123**), where it often threatens to occupy fields and pastures almost to the exclusion of other vegetation. It has received the name "tar weed" on account of the sticky hairs that cover its stems and branches, which when rubbed off by sheep and mingled with dirt in their fleece, gives them the appearance of having come in contact with tar (**36**).

There is no method of getting rid of this plant except renewing the pastures and fields in which it has become a pest, by thorough cultivation and enrichment.

EVENING PRIMROSE FAMILY.

55. **Fire-weed. Willow-herb.** (P.) *Epilobium spicatum*, *Lam.*

In newly cleared land that has been burned over, large areas of this tall brilliantly-pink blossomed plant with its willow-like leaves will often appear Phoenix-like from the ashes. This is the Fire-weed so called, which will often thereafter appear in fence rows and other untilled spots, where it tends to flourish as a constant feature of such places. Although stately and graceful in appearance, it is of no use to the farm and should be cut and composted with its companions before fruiting.

56. **Evening Primrose. Sun-drops.** (B.) *Oenothera biennis*, *L.*

A tall branching and fruitful weed with large yellow flowers which open at night and close on the rising of the sun unless the day be cloudy and wet. The illustration represents the top of the plant only, giving but little idea of its large coarse growth. This is one of the conspicuous weeds of old fields and neglected lands, as well as of roadsides and fence rows, where its flowers may be seen even on quite dark nights as their petals have the power of storing up sunlight and emitting a sort phosphorescence at night in consequence. As the plants are profuse seeders, they should be grubbed out, and destroyed during their flowering season.

Evening Primrose.

The young roots are said to be edible and pleasant either boiled or pickled, they having a "nutty taste;" and are used in some parts of France and Germany for the table. Medicinally, the plant has met

with considerable use in the South, where it is known as the "King's cure-all." Mr. L. J. Germain says of the uses of the plant: "In some of the Eastern States, it is said to be used as a diaphoretic in fevers, and is there known as 'fever plant'. It is also said to be used there in the harvest field under the name of 'coffee plant', for its invigorating qualities, and to slaken thirst and promote perspiration. In the Middle States it is generally known as 'scabish plant,' or wild Evening Primrose, and is in great repute for 'summer complaints,' such as ordinary diarrhœa, cholera morbus, bloody flux, Asiatic cholera, cholera infantum, etc. The young roots are also grated fine, pulverized or macerated with fresh lard, mutton tallow, or fresh butter, and applied as an unguent to cutaneous affections such as burns, scalds, felons, bunions, erysipelas, cuts and bruises. In the Southern states it is commonly known as 'king's cure-all,' and used by physicians to dispel gathering humors, such as boils or 'gatherings.' The negroes use it as an antidote for snake bites and as a poultice for wounds, causing them to heal by 'first intention.' For the latter purpose, the usual method of preparing the poultice by country physicians is by boiling the leaves with wheat bran."

"Another use for the plant is in cases of sun stroke. Its reviving effect in such cases and the relief of the attending apoplexy is wonderful, as I have experienced in my own person and observed in others. It is also used as a soothing stimulant by the aged, infirm, and hypochondrical. I have seen the tea used successfully to promote perspiration and check vomiting and spasms in a case of Asiatic cholera. I also used the same with good effect upon myself on one occasion in a case of ordinary cholera. On frequent occasions, during a series of years with a surveying party in the West, I have given it to my men for sudden attacks of bowel complaint. always with good results. In some cases better results seem to have been obtained by a slight addition of alcohol to effect a more complete solution of some of the gummy principles. Sulphate of ether, instead of alcohol, has been used in desperate cases of cholera infantum and for the diarrhœa which often follows scarlet fever."

"I should also add that the blossoms placed in water form a mucilage excellent for inflamed eyes."

57. Sun-drops. "Wild Beet." (B. or P.) *Oenothera fruticosa, L.*

This species bears a general resemblance to the last, differing from it, however, in that it does not grow as tall, and bears a greater profusion of flowers and fruits. One of our farmers remarks in sending me a specimen of this weed; "I bought in 1889 an old field that had not been plowed for years. I plowed it and sowed in oats and grass in 1890; these ugly hard weeds, came up thick and grew some three or four feet high, with stalks from one-half to three quarters of an inch thick, very hard to cut. I think this is a bad weed in a wheat crop." (13) Lands infested with this plant should be thoroughly improved both by cultivation and thorough and

methodical fertilization, followed by a crop requiring good full cultivation.

The value of this weed as a component of the compost heap is quite low compared with many others, its analysis showing only 1.05 per cent of nitrogen; 0.39 per cent of phosphoric acid; and 1.68 per cent of potash, yet this should not discourage its addition to the heap early in its flowering season.

This plant when young is used with the last as a pot herb (88), and in domestic practice meets with the same medicinal use. It is also used for croup (34), and as a vulnerary for recent wounds.

GOURD AND MELON FAMILY.

58. **Wild Balsam Apple.** (A.) *Micrampeles echinata*, (Muhl.) Raf.

This climbing or running plant so often cultivated for arbors, and with the false impression that it beautifies old sheds and fences by its growth,—a point that could be much better proven by the painter and carpenter—may be known by its five divided grape-like leaves, minute flowers, and fleshy egg-shaped weak-spined fruits, that burst at the point and eject their seeds together with the juice of the fruit. Escaping from cultivation in this State to damp waste places and fence rows, it soon fails to look ornamental and becomes justly considered as a nuisance. It should be torn away at the root before the fruits are formed.

PARSLEY FAMILY.

As the name denotes, all plants of this family bear a general resemblance to the common garden parsley. They all have more or less umbrella-like heads of small flowers; mostly fine or numerously cut leaves; and a peculiarly shaped double-winged seed, with ridges and minute oil cells between. There are many aromatic forms in the family such as anise, coriander, fennel, lovage, etc., and many of the plants are poisons of greater or less virulence, though this property is generally lost in cultivation or by cooking; like the parsnip, carrot, etc.; or by bleaching, like the celery. The peculiar pungent, rank odor of the bruised plants of any member of the family will serve as a point of recognition.

59. **Wild Carrot. Devil's Plague.** (B.) *Daucus Carota L.*

The finely cut leaves, flat-topped white flower cluster and bird's nest-like fruiting cymes of this most aggressive and pernicious weed are becoming so well known as to render a minute description of this plant unnecessary here. This species has proven itself our most aggressive weed, being now represented in every county of the State. It is considered a new weed in Wood


Wild Carrot.

(206); Wetzel, in 1889 (33); Brooke (250); Morgan (175); Hampshire (171, 216); Grant (242); Jackson (51,121); Pendleton, where it is being carefully watched and exterminated (70,268); Greenbrier about Lewisburg, but has not yet reached Frankford, fourteen miles from there; Summers (244); and Harrison counties. The seeds of this plant are usually brought in grass and clover seed, and are disseminated in many ways when once established. The seeding heads curl up when ripe, enclosing the seeds until late in the season or even far into the winter, when becoming broken, the seeds are scattered far and wide during blustery weather; sometimes the whole head is broken off and driven over the snow by the wind into adjoining fields and pastures. Fifty thousand seeds have been counted upon a single plant of the average size.

The wild carrot being a weed of uncultivated places, meadows, pastures and waste spots, the method of its eradication is evident, *i. e.* cultivation; and this should be followed industriously where the plant is prevalent. When only plentiful or infrequent, it should be carefully cut down before going to seed. Two years of this work will clear out the stand. Composted, it is of considerable value to the farmer, as it will not only recover to him a large quantity of nitrogen and potash (see part I.), but it will also tend to keep the weed off his place. Sheep on short pasturage will eat off the tops, thus preventing the plant from fructifying (121), but this can not be considered a good means to utilize against the weed, as it would be far better for the farm and sheep as well to remove such weeds and leave more room for good grass.

To conclude: the wild carrot is one of three of our most aggressive weeds; it is absolutely good for nothing except in the compost heap, and not worth growing for that purpose; altogether, it should be watched with the utmost care, and never allowed to come to maturity. For further data upon the plant see chapters on Distribution and Bad Points of Weeds.

60. **Angelica** (P) *Angelica villosa*, (Walt.) B. S. P.

Another weed of the same general family characters as the last, from which it differs mainly in its lower and more leafy habit, and its dense covering of silky hairs. This rank weed generally grows in dry fields and meadows and should be looked upon with the deep suspicion that all species of this family deserve. It is certainly poisonous and unsightly and should be grubbed out whenever noticed; especially as its aggressiveness is as yet uncertain.

61. **Cow Parsnip. Masterwort.** (P) *Heracleum lanatum, Michx.*

A tall, stout, rough, wooly, strong-scented plant, with large, thrice-compound leaves, grooved leaf stem, broad flower heads, and a general rank and unsightly appearance. It grows in damp meadows and pastures, and has a very doubtful reputation, considering which it should be cautiously removed from the farm with the mattock.

The root in a fresh state is very acrid, inflaming and blistering the skin wherever touched by it, and is poisonous if taken internally. Small doses have been recommended for epilepsy, and various like nervous diseases, as well as for asthma, and apoplectic attacks.

62. **WILD PARSNIP. "QUEEN-WEED"** (B) *Pastinaca Sativa, L.*

This common garden vegetable in its wild degenerated state is very unsightly and one of our aggressive weeds. In this condition it is tall, stout, deeply grooved along the stem, bears large clusters of yellow flowers, and larger fruits than any other prominent member of this family. Its aggressiveness is positive and should be diligently checked by grubbing out all plants seen before the fruits are formed.

Although the cultivated root is succulent, sweet, nutritious and very pleasant to many, yet it is acridly poisonous in its wild state and causes vomiting and inflammation of the stomach and bowels even after cooking. In several cases of poisoning recorded, the symptoms of delirium pointed to this plant as a severe gastric irritant with reflex cerebro-spinal exitation. The seeds have been used in ague, but how effectively I can not say. In Ireland, a beer is made from the cultivated roots with hops, also a wine, while a kind of rum is at times distilled from them.

63. **Water Hemlock. Beaver Poison. Spotted Cow-bane.** (P.) *Cicuta maculata, L.*

This weed of the damp meadow and broookside, is another of the poisonous members of this family. It may be recognized in addition to the illustration here given, by its purple stem, slender habit, and pungently aromatic odor. Nearly every year some account may be seen in the Press of the country, of cases of poisoning of children from eating of the root; and on this account, if no other, this and every member of this family should be grubbed out from the farm lands the moment they are recognized.

Cow-bane.

The symptoms of poisoning are: Pain in the bowels; vomiting, followed by violent continuous convulsions: dilation of the pupils; frothing at the mouth, and death.

64. **Harbinger-of-spring.** (B) *Erigenia bulbosa, Nutt.*

This little vernal member of the family I should hardly consider a weed had I not noticed last spring two cornfields in this county absolutely covered with it. It is a low, smooth, almost stemless, few flowered plant, springing from a deep round tuber. This plant would hardly persist in lands subjected to cultivation especially if properly drained.

SPIKENARD FAMILY.

Plants of this family bear some little resemblance to those of the last; differing mostly in bearing berry-like fruits instead of seed-like carpels.

65. **Angelica Tree Hercules' Club.** (P) *Aralia spinosa, L.*

This large shrub or low tree with its immense pompon-like masses of small white flowers, and stout prickly stems and stalks, bears some resemblance to the sumac when in flower. It generally grows along the banks of runs, or large streams, though I have met with it frequently on hillsides and in pasture lands far from any stream; it thus shows points in aggressiveness which should warn us that it may not prove as innocent as may seem at first glance, grub it out before the fruits are ripened. It is of no use.

WOODBINE FAMILY.

66. **Elders.** (P.) *Sambucus Canadensis, L.*

There is probably no plant in the weed category that has caused more "sweat of the brow" than this innocent looking shrubby species. Its persistent sprouting from the roots, which are very tenacious of life, renders it most difficult to subdue; even plowing it up frequently only scatters it the more. The talent of this weed for spreading seems to be almost unsuppressible, one of my correspondents entirely removed a large growth of this species simply by cutting it close with a hoe (98), others have signally failed. Cattle can not be grazed close enough to starve them into eating even the young sprouts (90) in some localities; in others even if stripped of their leaves by sheep, they continue to grow year after year without apparent injury. The only method of subduing them is by the constant use of the mattock. With this as with the Canada Thistle "eternal vigilance is the price of freedom."

Economically the berries are often used for making wine, or as a fruit for pies, but this use must spring from necessity rather than from choice.

In domestic medicine, this plant forms almost a pharmacy in itself, and has been used substantially as follows: A decoction of the flowers and leaves, or an ointment (69) containing them, is used as an application to large wounds to promote healing and prevent deleterious consequences from flies; the leaf buds prove a violent and unsafe cathartic; the flowers, in warm infusion, are stimulant, exci-

tant and sudorific ; in cold infusion, diuretic, alterative and laxative — even for horses (132) ; they are also employed in ointment as a discutient. The inner bark is a severe hydrogogue cathartic, emetic, deobstruent, and alterative, valuable in intestinal obstructions and dropsy. The berries prove aperient, diuretic, diaphoretic and cathartic ; valuable in rheumatic gout, scrofula and syphilis —the juice making a cooling laxative drink. The leaves, worn inside the boots, will prevent galling, and are often used for like purpose under the collars or saddles of horses.

BUTTONWEED FAMILY.

67. **Bluets. Innocence.** (P.) *Houstonia caerulea, L.*

This humble little plant which dots or patches our pastures and meadows in early spring with its sky blue flowers with a yellow eye, does more harm than is readily imagined by crowding out with its spreading habit much grass. Fields that are too much given to it will generally be found to need renewal, and should be treated as recommended in Part 4.

68. **Houstonia.** (P.) *Houstonia purpurea, L.*

A small erect plant with narrow grass-like leaves and little funnel form purple flowers in a terminal cluster.

This is an herb of the woodlands, but in this State quite plentiful in old fields and pastures. Fields in which this weed grows will be found so overgrown with pennyroyal, cinquefoil and sorrel, as to need thorough renewal as advocated in Part 4.

69. **Cleavers. Goose-grass. Bed-straw.** (A. or P.) *Gallium Sp.*

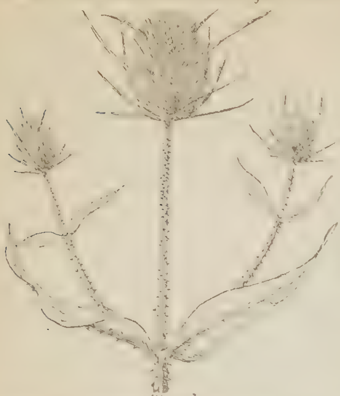
In all damp spots of the farm will be found a variety of low vegetation that renders them unsightly and gives the fields in which they occur a very unkempt appearance. Among this vegetation, some species of this class will usually be found. They may be distinguished by their square stems having small leaves clustered around them at regular intervals, by their weak habit, by their small white flowers, and by the tenacity with which some of them cling to the clothing, they being beset with minute hooked prickles along the angles of the stem. As cattle and sheep are often worried, and wool injured by these plants, the spots in which they grow should be drained and cleared away thoroughly, as these plants will not thrive if bereft of moisture and the friendly shade of larger vegetation.

TEASLE FAMILY.

70. **Teasle. Water-thistle. Tall Thistle. Fuller's Card. Indian Thistle. Huttonweed. English Thistle.** (B.) *Dipsacus sylvestris, Mill*

Of the many course weeds of the State, I know of none that have

been so much the object of questioning remark and wonder, and less



Teasle.

attempted against, than this introduced member of a small but aggressive family. The teasle is a tall, prickly, strictly upright plant, with large opposite leaves meeting and forming a cup at the stem, and terminated by numerous long-stalked egg-shaped prickly heads as in the illustration here given. The plant was introduced from Europe into the eastern United States at an early day that the heads might serve for carding wool; and its growth was encouraged for that purpose. Those grown upon a farm in Greenbrier county in this State were thus protected by Volnez, the illustrious historian, as he predicted for the locality a great manufacturing center (218.) From such points it has escaped and spread widely. It often forms such dense thickets that cattle will not attempt the passage of them (278.) The plant is called "Water Thistle," from the large amount of rain water often found in the cups of the leaves at their junction with the stem, and in the hollow stems themselves when cut (229.) It is called "Hutton-weed" in Randolph county from having first been found upon the farm of Col. Elihu Hutton's father. It is more often looked upon, however, as the Canada Thistle by those who have never seen the latter plant. It has proven itself a very aggressive weed in Cabell, Marion, Marshall, and several other counties.

The teasle grows mostly on dry banks, along roadsides, in old fields, and on hillside pastures: from whence it is easily eradicated by the diligent use of the mattock before its fruits are ripe, for a few consecutive seasons.

ASTER AND DAISY FAMILY

Wild Sunflower.

This is the largest family of plants in North America, and to it belong all those plants having heads of flowers of two kinds like those seen in the illustration above; the flowers of the margin (b) are called ray florets; while those of the center (a) are called disk florets. The asters, daises, dahlias, chamomiles, sunflowers (the subject of the illustration), and over three hundred other forms characterize the family. All the plants represented in this country seem to have a greater or lesser tendency to become weeds, especially as almost all of them have some form of self-distributive growth particularly adapted to render them aggressive. The seeds are either little parchutes prepared to be blown about by the wind; or winged for a like end; or furnished with hooks or barbed points to attach them to the hair of animals; or are small hard nutlets especially adapted to pass through the intestinal tract of any animal eating them, without injury to themselves.

71. **"Devil's Grandmother," "Tobacco-weed."** (P.) *Elephantopus tomentosus, L.*

A roughish, hairy, stout herb, with compound heads, dark green leaves, and purplish flowers. This plant shows a strong tendency to become a noxious weed in this State; especially in some parts of Upshur (12), and Harrison (33) counties. It should yield to grubbing in a few seasons.

72. **Iron Weed.** (P.) *Vernonia Novaeboracensis*, Willd. and *Vernonia altissima*, Nutt.

There are several species of this tall, coarse, hard weed in the State, principal among which are the two mentioned above. They are characterized by their erect growth, strict leafy stems, long pointed leaves, and small purple heads of flowers at the apex of the plant. The hard woody stem of this weed renders it a particular nuisance to farmers who find it difficult to cut down; it is from this fact that it receives its vulgar name "Iron Weed." The proper method of eradication is to grub up all plants each season before blooming, and if they persist after that, the fields upon which they grow should be properly underdrained. This proceeding will render the land far more profitable, and will effectually remove not only this species, but several other weeds that accompany it.

The bark of the root is used in domestic practice as a bitter tonic; and in rheumatism (190).

73. **Queen-of-the-Meadow Quill-wort. Indian Gravel Root.** (P.) *Eupatorium purpureum, L.*

A tall, graceful plant 4 to 10 feet high, growing erect and strict, surmounted by a large mass of reddish pink blossoms. The leaves are arranged in a circular manner at regular intervals around the stem; they being long, pointed and sharply saw-toothed upon their margins. This species grows like the last in moist ground, and is amenable to the same treatment. It shows a high value as a manurial substance, as it contains 2.07 per cent. of nitrogen; and 2.11 per cent. of potash.

As a family remedy, the root has met with considerable use, especially as a sudorific in fevers (276), particularly those of an ague type. It has also an established reputation as a diuretic in dropsical affections (68, 217); kidney troubles (124, 135, 181, 201, 207, 266); and for gravel (202, 207, 267); especially in chronic forms of these troubles. It is also extensively used, like the last, as an astringent tonic.

74. **Round-leaved Boneset.** (P.) *Epatorium rotundifolium, L. var. pubescens, (Muhl.) B. S. P.*

A plant growing in drier grounds than most other species of its type. It bears considerable resemblance to the common boneset in its flowers, which are, however, smaller; but the leaves are small, egg-shaped, and saw-toothed on the margins, and do not clasp the stem at their bases as in common form. As a weed this species frequents pastures, dry hillsides and roads, and is becoming too common and unsightly to be allowed to flourish. It should fall to the scythe with other filth.

75. **Boneset. Thoroughwort. Feverwort.** (P) *Eupatorium perfoliatum*, L.

This is one of the most well known of our moist land plants; its clusters of small white flowers, and light green veiny foliage set closely about the stem are characters not to be mistaken. When existing as a weed as it often does in wet meadow lands, it can be eradicated by the only method of reclaiming such, that is to say by thorough tile draining.

There is probably no plant in American domestic practice that has more extensive or frequent use than this. The attic or woodshed of almost every country farm house, has its bunches of the dried herb hanging tops downward from the rafters during the whole year, ready for immediate use should some member of the the family, or that of a neighbor, "take a cold." How many children have winced when the maternal edict: "drink this boneset; it'll do you good," has been issued; and how many old men have craned their necks to allow the nauseating draught to the quicker pass the palate! The use of a hot infusion of the tops and leaves to produce copious perspiration was handed down to the early settlers of this country by the Aborigines, who called it by a name that is equivalent to ague-weed. It was first introduced, as a plant, into England in 1699; but was not used in medical practice, even in this country, until about the year 1800. It has now a place in every work on Medical Botany which treats of North American plants.

Boneset produces perspiration only when given in generous doses of the hot infusion; a cold decoction is claimed to be tonic and stimulant in moderately small: laxative in medium: and emetic in large doses. It is also said to be anti dyspeptic and anti-rheumatic. It is prominently adapted to the cure of a disease peculiar to the South known as break-bone fever (Dengue), and it is without doubt from this property that the name "Boneset" was derived.

This herb has also been found to be curative in intermittent fever, bilious fever, bilious colic, typhus and typhoid conditions, influenza, catarrhal fever, rheumatism, lake fever, yellow fever, and remittent types of fevers in general. Many of the earlier works allude to this species as being diuretic, and therefore of great use in dropsy. This is evidently an error of substitution, No. 73 of this list being without doubt the species used.

As a family remedy, its use in this State has become very common; it being considered a specific for a great variety of troubles, but especially for colds and fever (**2, 12, 26, 34, 43, 100, 126, 139, 143, 152, 171, 175, 238, 244**); for coughs, colds and hoarseness (**3, 12, 73, 138, 169, 188, 214**); and for malarial fever (**124, 153, 186, 204, 276**). Its use as a tonic (**124**), and remedy for deranged liver (**128**), as well as a stomachic (**29**), emetic (**124**), and cathartic (**124**), is quite general.

76. **Mist Flower. Blue Boneset.** (P.) *Eupatorium cœlestinum, L.*

This species has the general characteristics of the round-leaved boneset, but differs in its larger, sky blue flowers and larger, coarser toothed, longer stemed leaves. It flourishes in either moist or dry fields, preferably the former, and will yield to the usual methods used to kill out its friends and neighbors: drainage or the scythe. It has not had, to my knowledge, any particular use as a medicine.

77. **Golden Rod. Yellow Top.** (P.) *Solidago sp.*

This, the chosen flower of our nation, while graceful and aesthetic to the eye of the civilian, is looked upon with anything but inspiring thought by the agriculturist. Its wiry stems, sprangling yellow tops, and aggressive nod to every passing breeze, causes him to anathematise it rather than sing of its beauty. Notwithstanding all this, the graceful curves of its stem, branches, and sprays of golden flowers are worthy of more than one lingering thought of the beautiful 'ere it is rendered obnoxious by classifying it with trash of the field.


Golden Rod.

It should be mown down with other weeds before fruiting, and the lands which it infests given better cultivation and more nourishment.

Late medical discoveries have proven this plant to be a very efficient diuretic in some forms of kidney troubles.

78. **Daisies.** (A. & P.) *Aster sp.*

There are a large number of species of asters in the State all of which, with their blue or white flowers, bear some resemblance to the next species. All of them are unsightly weeds upon the farm, and should be cut and composted ere they mature their seeds. The directions given for gathering weeds in Part I of this bulletin will

prove excellent measures against these species if followed care fully.

79. "White Devil." "Wire-Weed." "Devil Weed." "Old Virginia Stick-Weed." "Old Field Sweet." "Farewell Summer." "Nail Rod." (P.) *Aster lateriflorus,* (*L.*) *Britt. var. hirsuticaulis,* (*Lindl.*) *Gray.*

There are few weeds in this State that have caused so much comment as this scraggly branched, profuse blooming little aster, with its wiry stems clothed with minute leaves intermingled with small clusters of close growing white or blueish flowers.

White Devil.

Mr. J. W. Miller, Cabell county, says of this weed: "The Nail Rod that has been here for 10 or 15 years has white or purplish flowers in the fall, grows up 4 or 5 feet, stalk dies every winter and sprouts up from the root again in the spring. It grows on fields that were in grain the year before, and laying fallow the next. It grows thick as a rye field. We do not consider it bad, as it is a good fertilizer and any kind of stock will eat it and kill it out. We never find it in our pasture lands."

Mr. George A. Alexander of the same county says: "The Farewell Summer, I am told, is a common weed in Virginia. It commenced growing here in this and adjoining counties about eight or ten years ago, and I consider it a very troublesome weed. I hear general complaint from farmers concerning it. It does not grow very fast until about July or August, after which it begins to bloom in little clusters of white blossoms, and continues to do so until frost kills it. Fields sown in clover and not pastured till the bloom ripens, are utterly ruined unless the weeds are previously mown down, and even then the clover roots are badly damaged. Cattle will eat it while it is in bloom, because it is at that time almost impossible for them to find anything else; they seem to like it at that time, but do not thrive well upon it. If it is not mown down the stalks remain erect till clover cutting time the next year, when it is almost impossible to cut them with any safety, for they are as hard as sticks, hence the origin of the name 'Stick Weed' I am told that it usually grows on old worn out fields in Virginia, and that is why it is called by some 'Old Field Sweet.' In this locality it usually grows fastest, and is most troublesome, on our best lands."

Gen. Jno. McCausland, of Mason county, says: "White Devil, a weed growing on heavy exhausted clay land, I think will become very troublesome. The stem is very hard and woody, and it branches like a pine tree. I have seen fields so covered with it that they had the appearance of a buckwheat crop."

This weed is considered new in Mason (170), Cabell (229), Kanawha (154), Wayne (178), and several other of our southern counties. It is often mentioned as being relished by sheep and cat-

tle (**154,229**), and is an excellent late, honey producing plant (**178,191**).

Fields infested with this plant should be cut over while the weed is in flower, and the crop gathered and composted; which, as the plant contains 1.92 per cent. of nitrogen. 0.56 per cent. of phosphoric acid, and 1.61 per cent of potash, will fully repay the trouble especially as the seeds are thus destroyed, and the roots will not outlive such treatment many seasons.

80. **"Blue Devil." "Stick Weed." "Bee Weed." "Fall Aster."** (P.) *Aster cordifolius, L. var. laevigatus*, Porter.

This aster differs from the last in its taller growth, larger lower leaves, longer and less straggling branches and its generally larger and bluer flowers growing mostly on the end of the smaller branches. It is considered a weed much as the last species, and sometimes the names are intermixed for both.

It is considered a new weed in Greenbrier (**142**,) Upshur (**270**), Barbour (**180**), Harrison (**22**), Jackson (**115, 200, 201, 256, 273**), Roane (**136, 159**), Braxton (**108, 255, 266**), Wetzel (**105**) and Wirt (**39, 125**) counties. This species, is in fact, to our central and northern counties, what the last is to the more southern.

Mr. J. P. Campbell, of Jackson county, says of this weed: "The Blue Devil will prove a blessing to all our farmers that fail to sow grass, as it grows very thick on the ground furnishing shade for the land, giving it a chance to recuperate from the effects of exhaustive farming; in fact, for some kinds of soils, I am not sure but that it is an excellent fertilizer. Sheep and cattle eat it, and sheep will soon eradicate it in their pastures; but if left to ripen it leaves a stiff, woody stem full of branches, which on good land will be four or five feet high."

This is also one of our late bee plants, being frequented by these honey gatherers as one of their last chances of the season.

It should be cut and composted before flowering, which, as its analysis shows 1.49 per cent. nitrogen, 0.52 per cent. phosphoric acid and 2 25 per cent. potash, will fully repay the trouble.

81. **Butter weed. Horse-weed.** (A.) *Erigeron Canadensis, L.*

This erect, greatly branched, hairy weed, with its top of small aster-like flowers, and its slender grass-like leaves, is generally found along roadsides, in waste places, and covering old fields especially along the Great Kanawha river bottoms, and in the valleys generally. As it is a profuse seeder, and as its fruits are capable of flyin the air like those of the dandelion, the plant should be cut and composted before thev are ripe.

An infusion of the pl nt has often proved an excellent remedy for spitting of blood in people of dark complexion; also as an astring nt in diarrhoea and dysentery. The oil is, however, the most useful, in doses of from four to six drops per hour.

82. **White-top. Daisy Flea-bane. Sweet Scabious.** (A.) *Erigeron annuus*, Pers.

This common White-top is a tall daisy-like plant of the pasture and meadow. The stem is stout, leafy, hairy and branching; the leaves egg-shaped, pointed, and sharply and coarsely saw-toothed along their margins; the flowers are white and clustered at the summit of the plant. Although this weed is very unsightly in meadows and a source of general disrespect, it is not particularly obnoxious, as cattle do not refuse it when it is cured with the hay; yet, could our farmers see the white meadows of the northern and middle states where this weed is plentiful, they would immediately see the necessity of keeping weeds from seeding whenever possible.

Its astringent properties are considered by some Agriculturists a valuable element in stock feeding (**210**.)

83. **Old-Field-Balsam. Everlasting.** (A.) *Gnaphalium obtusifolium, L.*

One of the most noticeable of our old field weeds is this pearly-white member of this family. Its large bunch of wooly heads, whitish stems and branches, and tendency to preserve its form of flower and leaf very late in the season, as well as its slight balsamic odor, are points of recognition known to every farmer. Being a weed of fallow lands, the methods of renewing such mentioned in Part 4, of this bulletin will be sufficient to eradicate it if followed.

A hot decoction of this plant proves pectoral and somewhat anodyne, and is therefore often used as a remedy for coughs (**39**,-**94**, **220**); it is also sudorific and useful in feverish colds (**38**). Hot fomentations of the herb are used like arnica for sprains and bruises, as well as a poultice for unhealthy ulcers. The dried flowers and leaves form excellent filling for the pillows of consumptives, their balsamic exhalations often giving ease to the cough and rest to the patient.

84. **Low Cud-weed.** (A.) *Gnaphalium, ulignosum, L.*

This little prostrate, spreading, silvery herb, having much of the general characteristics ol the last, is found in moist spots of meadows and pastures. Thorough drainage will readily eradicate it.

85. **Elecampane.** (P.) *Inula Helenium, L.*

This tall stout graceful herb, with its large leaves whitish-wooly beneath, and large heads, is a well known pasture and road-side weed in many parts of the State. It is a native of southern Europe, and grows spontaneously in damp places in the United

Elecampane.

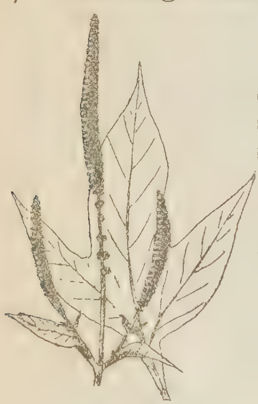
States. It is of little use and should be grubbed out and destroyed before the flowering season, as there are few weeds that give a more ragged, slovenly appearance to a field than this after its flowering season has passed.

The root is large and has a camphoraceous odor and mucilaginous juce. On this account it was one of the most famous of ancient medicines. As far back as the Hippocratic writings, it is stated to be a stimulant to the brain, stomach, and kidneys. In this State, it is often used for lung troubles (**45**), and for colds when accompanied by cough (**37, 45, 94, 112, 139.**)

86. **Leaf-cup.** (P.) *Polymnia Uvedalia, L. & Canadensis, L.*

Large, coarse, stout, hairy and heavily odorous plants, with immense thin lobed leaves, and light yellow heads of flowers ; growing mostly in moist shady places, but often in our mountain counties seeking open pasture lands and meadows. A careful farmer will remove them with a mattock, when locking out for the welfare of his fields and stock.

87. **Tall Rag-weed. Horse-weed.** (P.) *Ambrosia trifida, L.*



Tall Rag-weed.

This tall form of the rag-weed, with its erect stems tri-lobed leaves and three forked spikes of minute yellowish-green flowers ; is a general habitant of rich fields, where, if left to itself it forms a dense growth choking out most other plants. It will yield to frequent cutting which should be done before the tops flower.

This species is especially enjoyed by horses and hogs, which seem to find in it a tonic bitter pleasant to their palates.

88. **Rag-weed.** (A.) *Ambrosia artemisiaefolia, L.*

A low omnipresent species with doubly divided leaves, many branches, and numerous spikes of greenish yellow flowers. This is one of the very few weeds the vulgar name of which is national. The rag-weed is the commonest weed of the stubble field, and can only be subdued by constant and careful cultivation. Sheep appear to be very fond of it, and in some counties of this State it is harvested and stacked to serve as a winter fodder for them (see chapter on Weeds as Fodder for Stock in part 2 of this bulletin.)

The medical uses of this plant are but slight, the principal

being as a bitter astringent for diarrhœa (30), and summer complaint (224). It has met with some uses in fevers (181), and in Maryland was once used as a substitute for quinine, but with little success. It is claimed to be a successful application to parts poisoned by poison ivy, if rubbed in until the skin is discolored by its juice.

Of late years much attention has been called to the species of this genus—especially this and the preceding plant—as being, through their pollen, the cause of hay-fever, many people affected with this troublesome disorder laying the charge direct. It is true that when the pollenation of this plant is begun, this disorder generally commences in those people subject to it, and only ceases when the plants are out of flower. We have had the pleasure of curing several patients with this disease, all of whom had asthmanic symptoms at the height of the trouble, with drop doses of the tincture given three times per day.

89. **THORNY CLOT-BUR.** (A) *Xanthium spinosum, L.*

This Clot Bur is as yet little known to the farmers of this State, but I have noticed an increased abundance of it during the two seasons I have botanized in the State, and fear that it is to become one of our most obnoxious weeds. Not only are the burs as adhesive to wool as those of the next species, but the stem is thorny as well. I have noted it along road-sides in Jefferson, Berkeley, Mineral, Kanawha and Wood counties. Its distinguishing characters are: its leaves, which have three white ribs upon their dark green upper surface and are silvery white beneath; its stems and branches which have three long, stout, golden yellow thorns at the base of each leaf, altogether making one of the most formidable of weeds, and one that should be watched and cut down before going to seed.

90. **Clotbur. Cockle-bur. Cuckle-bur.** (A) *Xanthium Canadense, L.*

A common weed of ditches and damp places, characterized by its brown-speckled stem, large, ovate, long stemmed toothed leaves, and spiny fruits growing singly or in clusters from the base of the leaf stems


Clotbur.

The clotbur is a weed as much detested by shepherds as the burdock, and with good reason, as the fruits can not be released from the fleece without cutting out and wasting a considerable quantity of wool

Fields infested with this weed should be reclaimed by under-drainage, and small sections of land given up to it should receive the same treatment.

91. Nigger-head. "Yellow-Daisy." "Brown-eyed Susan." (P.) *Rudbeckia sp.*

Nigger-head.

This daisy-like flower with its deep orange-yellow rays and dark purple almost black button-like center, can not fail to attract the attention of the farmer, who is now realizing in the growth of this species what aggressiveness in weeds really signifies; as it was but a few years ago a rare plant in this State, while now many fields are almost one solid mass of color from its presence.

It frequents meadows and pastures as well as fallow land, but seems to prefer the former. It should be carefully cut down while in bloom to prevent its spreading by means of the seed.

92. Wild Sunflower. (P.) *Helianthus sp.*

We have in this State as far as I have noted fifteen species of the wild sunflower, at least one-half of which are taking upon themselves the nature and characteristics of weeds. They grow in all kinds of soils and many appear to be quite aggressive. The cut at the beginning of this family will give an idea of the character of their flower.

Wild sun flowers should be cut during their flowering season, and composted to guard against trouble from their multiplication.

93. Wing-stem. Stick-weed. (P.) *Actinomeris alternifolia, (L.), DC.*

.all branching weed with its stem and branches winged upon the angles, saw-toothed, feather-veined leaves, numerous yellow daisy-like flowers, and globes of winged seed, threatens to become a fearful pest along our greater river bottoms. An average plant produces 212 ball-like heads each having an average of forty seeds, giving a yield of 8,480 seeds to the plant.

Wing-stem.

Mr. J. W. Miller, of Cabell, says of this weed: "Our worst weed here on good ground is the Stick Weed, which grows about 4 to 6 feet high, has yellow blossoms in Fall. It only grows in some parts of our county. When it gets a start, the ground has to be broken, or the weeds grubbed out. No stock will eat it. I have known pasture land to be cut over for years without killing or even thinning them out."

This weed should be grubbed out and composted before the flowers have been opened, as the younger ones often mature their seed while later ones are blooming. This will probably account for the lack of success mentioned in the letter above.

94. **Wild Coreopsis.** (P.) *Coreopsis sp.*

Several species of these plants, mostly quite similar to the last except that their flowers are more like those of the wild sunflower, escape from open woods and shrubby hillsides to our drier pasture lands, where they threaten to become more or less obnoxious to the farmer. If cut and dealt with as other trash according to the directions given on page 125 of Part 1 of this bulletin, they can not fail to be subdued.

95. **Stick-tights. Beggar's Ticks. Pitchforks.** (A.)
Bidens frondosa, L.

Who of our farmers are not acquainted with the small, flat, two-tined seeds of this miserable weed, that sticks to their clothing and the hair of their animals in the early autumn. Most moist spots of the farm annually yield millions of these seeds from plants whose flowers show plainly their allegiance to this family. These seeds, as well as others bearing these names, will be found illustrated in the plate explaining the chapter on Weeds Detrimental to Wool in Part 4 of this bulletin.

Those spots on the farm yielding heavy growths of this species need under drainage to fit them for paying crops, and this measure will readily kill out the weed.

96 **Spanish Needles.** (A.) *Bidens bipinnata, L.*

Two particular characters distinguish this plant from the above: first, the leaves are finely divided into numerous portions; and second, the seeds have three to foúr long tines barbed down their sides. The true Spanish Needle (this species) grows also in dryer situations than the last often choosing even rocky soil. As a weed, it is more of a pest to shepherds than the last, and more difficult to eradicate. The plants should be pulled up when noticed or, if existing in large numbers, should be cut down before they mature their seed.

The only medical use I know of for this species is that of a decoction of the leaves for croup (**142**), and how effective this may be I am not prepared to say.

97. **Dog's Fennel. May-weed.** (A) *Anthemis Cotula, L.*

This common weed has become, since its introduction from Europe, thoroughly naturalized throughout the cultivated regions of North America. Its particular choice of soil and location is roadsides and along the paths worn by cattle about the farm; though it often spreads into dry fields and pastures in general. It grows from 1 to 2 feet high, branches profusely, and bears numerous white daisy-like flowers the rays of which droop back toward the stem in age, exposing the button-like yellow center. This character, together with the finely divided yarrow-like leaves readily distinguish it. Dog's Fennel should meet with the same fate, as all of its family by being cut and destroyed before its fruits are ripe.

Dog's Fennel.

The plant when cut and cured until black, is readily eaten by cattle (**55**). In family medicine, it has been used much like its near relative chamomile for colds (**258**, **267**) and colic (**21**, **131**, **154**.) The blossoms are also used in decoction for flux, either alone (**55**, **97**) or mixed with the leaves of the Smartweed (**124**.) The plant has been somewhat used for sore throat (**224**, **271**,) and for diphtheria (**131**) though probably not the true type of that disease. The leaves, bruised and bound upon the places affected, are said to relieve the pain of neuralgia (**98**.)

98. **Yarrow.** (P.) *Achillea Millefolium, L.*

This weed is growing to be very common in this State, where its flat-topped clusters of white or slightly pinkish flowers, and its finely dissected leaves are becoming but too thoroughly known. It is somewhat aromatic and too strongly bitter for our cattle to even nibble at it. It should be grubbed out in June and September before its seed are ripe. Its value as compost will be found on Page 124 of Part 1, of this bulletin.

The uses of this plant in domestic medicine depend mostly upon its astringent and tonic properties having been more or less curative in colds (**66**); croupy coughs (**264**); dysentery (**112**); dropsy (**194**) wasting haemorrhages (**88**); and in nocturnal eneuresis of children (**244**.)

Yarrow.

99. **OX-EYE DAISY. BULL'S-EYE.**

"SHERIFF PINK." (P.) *Chrysanthemum leucanthemum, L.*

This vile European pest is becoming but too well known throughout the United States. Its distinguishing characters are fully illustrated in the accompanying cut and need no further description except that the flower heads are white with a deep yellow center. The ox-eye spreads, not only by seed, but like the Canada Thistle, by root as well; and could our West Virginia farmers once see the solid white meadow lands of the North and East, where this plant has achieved almost absolute supremacy, they would never pass a single plant in this State until they had paused to destroy it. The gradual spread of this weed in West Virginia may be realized by examining the tables appended to part 2, of this bulletin. Ox-eye is considered new in Hampshire (**4, 71, 92**); Pendleton (**20, 268**); Preston (**93**); Upshur (**34**); Braxton, in 1887 (**146**); Harrison (**26, 95**); Jackson (**51**); and Wood (**89, 209**) counties. My correspondents in general, grant this weed the most prominent place among all those of the State. In some cases, it has escaped as a weed from flower gardens, where it is often cultivated for bouquets like its sister the chrysanthemum; it is more often introduced, however, in baled hay, and in clover and hay seed.


Ox-eye Daisy.

It has been introduced in some places as a fodder plant for sheep, though by close grazing they will exterminate it. This teaches a lesson of great value to our farmers, showing that sheep are the most valuable stock that can be grazed upon our lands, both as weed exterminators, and as highly profitable market animals. Correspondent (**188**) says: "I consider Ox-eye good food for cows, if cut when in full bloom and cured like hay."

Where this weed is abundant it is often used to restore worn out lands that are too poor to produce a good crop of clover. Our analysis shows that the plant contains 2.12 per cent. nitrogen; 0.46 per cent. phosphoric acid; and 2.88 per cent. potash. Its value is therefore high for this purpose; nevertheless cultivation of it as a manurial substance would be a dangerous experiment, and entirely useless while we have so much burdock, poke, bitter dock, thistle, fox tail, golden rod, iron weed, rag weed, wild lettuce, and like trash to use for the same purpose from our fallow lands. All this in the face of correspondent (**142**), who says: "I think the farmers of thin land should cultivate ox-eye daisy as it improves the land better than clooer and will make a better crop and more food for all kinds of stock." It may seem needless for me to add that this plant has proven itself too aggressive a weed to be introduced as a crop in any locality whatever. (See remarks on Weeds as Fodder for Stock, in part 2 of this bulletin.)

Prof. Seymour of Wisconsin, in whose ideas I fully con-

cur, speaks of this weed as follows: "To exterminate the Ox-eye Daisy from grass lands where it has got a hold is no small task, especially if it is generally diffused, unless there is a united effors on the part of all. A farmer finds little encouragement to clean it out from his own farm if he knows hundreds or thousands of seeds will be blown from his neighbor's farm on the roadside after a few weeks. It should never be allowed to seed ; but keeping down the stems will not prevent the growth of the root leaves, and so the roots and root stalks will be nourished and live on indefinitely. To kill it out in grasslands is very difficult, if not impossible. Annual plowing or regular cultivation for some crop for several years is recommended and ought to be effective ; but, unless the roadsides and fence corners are closely watched and cut over, all efforts will be thwarted by repeated seeding."

That quaint writer, Dr. Michener, in his Weed Exterminator, says: "Happily, this invader is sure to herald his approach, by deceitfully displaying a White Flag. While this need not to deceive, it must warn of the danger, and should lead to prompt, and vigorous resistance. It is not sufficient that the White Flag-staff should be cut down, and the Flag trampled in the dust, the farmer must industriously apply the glove, the hoe, the scythe, the plow, and that with little advantage to himself; if he does not know and act in accordance with his knowledge, that the daisy ripens its seed while yet in bloom. In other words, it retains its white ray flowers long after the proper flowering season has passed ; and time allowed for maturing the seeds. With a knowledge of this fact, the plants must not be suffered to remain on the ground, even after cutting, but must be effectually destroyed."

There is no Botanist nor farmer in the Eastern United States to-day but would agree with me in saying that, in a State like ours where this weed is not yet so plentiful, no self-imposed task would meet with more worthy praise than alert and watchful care exercised in the removal of every spray and root of this most agressive weed that appears upon the soil.

100. **TANSY.** (P.) *Tanacetum vulgare, L.*

In numerous localities in the State, this well-known medicinal plant with its finely cut dark green foliage and button-like yellow heads, has escaped to roadsides, fields and fence rows. It does not appear however, to be very aggressive, yet if not needed should be thoroughly rooted out and the spots watched and treated for several seasons until no trace of it is left. There is no telling what such weeds may do if left to flourish.

Tansy has been used as a carminative tonic since the Middle Ages ; especially in convalescence from exhausting diseases, in dyspepsia, jaundice and periodic fevers. A tea is often made of the plant and drank while hot as an anodyne in extreme nervousness ; this preparation is also used as a diuretic in dropsy, and a diaphoretic in fevers. The indiscriminate use of the oil of this plant by

women, as an emenagogue, should be discountenanced entirely, as it has proven to be of little use in this direction and numerous serious and even fatal cases of poisoning have followed.

101. **French Wormwood.** (P) *Artemisia sp?*

Along the Great Kanawha river, from Charleston to its mouth, thence northward to the center of Jackson county, a tall species of this genus has advanced with threatening persistence until, in some places, miniature forests of the herb have developed. It is said to have been introduced by a French Physician, who brought the plants with him from France, and cultivated them in his garden here. I have never met with the plant during its flowering season, and have not, on that account, been able to determine its species. The name is common in the neighborhood in which it grows, and with this alone to distinguish it, all farmers having it upon their lands or road sides should take measures to kill it out by grubbing before its flowers are developed.

102. **Indian Plantain.** (P) *Cacalia sp.*

Indian Plantain.

These tall plants are distinguished by their long stemmed leaves, pale above and white beneath, and their whitish flowers, together with their tall, erect growth, and should be destroyed by grubbing whenever found, as they seem to grow annually more aggressive in their character. In just how much they will prove obnoxious is yet a question, but in this weed, if in no other, "a stitch in time" should always be taken. Should new weeds appear upon your farms, do not let them grow until you find out their characters or you will more often than otherwise have cause to regret your delay. Kill them before they fruit.

103. **Fire-weed.** (A.) *Erechthites hieracifolia, (L.), Raf.*

Fire-weed.

Just as the other Fire-weed No. 55 appears first and most frequent in newly cleared land that has been burned over, so also does this species, which as readily spreads to moist or dry soils thereafter.

This fire-weed is a tall, coarse plant with large thin leaves, the lower ones triangular, and whitish flowers. It seldom becomes a weed except in rich, moist fence rows, whence its unsightly presence should be removed with the help of the scythe before the seeds ripen and float away in the air as most species of this family are able to do.

104. **BURDOCK.** (B.) *Arctium Lappa, L.*

This is one of the very few weeds that even the most negligent farmer is perforce compelled to remove from his land because of its peculiar habit of filling the houseyard and barnyard with its immense growths, and because if he does not do so his cattle are apt to become moving masses of its adhesive burs. A woeful sight indeed is the poor cow, whose tail hangs heavily downward—like that of the Mandarin's Ass—with its weight of Burdock burs too heavy to longer prove a protector against the last flies of the season. The shepherd must remove the plants or lose his fleece; here compulsion proves a remedy. The weed is so rank that man, the jackass, and caterpillar are the only animals that will eat of it. Repeated cutting below the crown of the root will rid the place of this most unsightly weed in two or three seasons. The plants so cut should be greatly prized as compost as they contain 1.85 nitrogen and 3.07 per cent. potash, both valuable fertilizers.

The young stems stripped of their bark may be eaten raw or boiled; as a salad with oil or vinegar, or as greens. In Japan, it is cultivated under the name of "gobo," and used much as we use salsify. The root has met with extended use as a tonic (**4, 145**) and blood purifier (**7, 14, 26, 37, 42, 48, 49, 57, 66, 69, 73, 74, 77, 85, 94, 111, 114, 109, 122, 131, 148, 149, 150, 160, 181, 183, 195, 213, 217, 220, 225, 231, 232, 249, 261, 264**). The seeds crushed and steeped form a decoction useful for stomach cramp and abdominal colic. The root has also been used for biliousness (**145**); for kidney troubles (**100, 123**); and for rheumatism (**110**).

THE THISTLES.

There has been so much written to me by my correspondents showing their doubts as to their ability to distinguish the different thistles, that I have taken some pains to show our principal species so arranged that their characters may be compared and their differences noted. In these cuts the sizes of the head are all relative one to the other. It will be noticed that the heads of the Plume thistle are the largest, that its leaves are long, quite broad and regularly scalloped and toothed; that the heads of the Boar thistle are smaller, that the leaves are very narrow and pointed, and that the stem is fully as prickly as the leaves; that the Virginia thistle has broad and but slightly scalloped leaves with few prickles, while the peculiar heads are still smaller than the last and not prickly at all; that the Canada thistle has the smallest heads of all and that they are grouped in clusters, that the leaves are broad, numerously scalloped and very prickly, while the stems are bare.

There is one other thistle in the State called the Swamp thistle, that has heads like those of the Virginia thistle, and leaves like the Plume thistle. This may be distinguished by its gummy adhesive heads.

The heads of the Plume thistle average one and one-half

inches in diameter; those of the Boar thistle one inch; those of the Virginia thistle three quarters of an inch; while those of the Canada thistle measure only from one quarter to one-half inch. The Plume thistle grows from 1 to 2 feet high; the Bull thistle from 2 to 4 feet; the Virginia thistle from 1 to 3 feet, and the Canada thistle about the same.

105. Boar Thistle. Purple Thistle. (B.)

Cnicus lanceolatus (*L.*) *Willd.*

This is our most common pasture thistle, characterized by its narrow green leaves, sweet purple flowers, and stems rendered very prickly by the continuances of the bases of the leaves down them. This species grows from two to four feet high and bears heads about an inch in diameter. It infests roadsides, meadows, and pasture lands from whence it may be readily removed by cutting it off below the crown of the root. The plant contains the large percentage of 2.44 nitrogen, and 5.53 potash, and will thus pay largely for the little trouble it takes to kill it, if properly composted after cutting.

A tea of the root is recommended for rheumatism (**88**), and neuralgia (**249**).

Boar Thistle.

106. Virginia Thistle. (B).

Cnicus Virginianus (*Michx.*), *Pursh.*

Virginia Thistle.

This thistle differs from the other three principally in its broad, slightly indented leaves, few prickles, and wooly stems. It grows from Virginia southward mostly in open woods and fields.

It is hardly plentiful enough in this State to consider it much of a weed, being included in this list principally for comparison with the other forms described.

107. **Pasture Thistle.** (B.) *Cnicus odoratus* (*Muhl.*), *B. S. P.*

This large thistle much affected by young ladies, who make beautiful pompons of the freshly opened flowers by stripping off the outer green scales from the heads which allows them when dry to take the form of a soft downy ball. This species grows mostly in our glade regions, but is also found on dry pasture lands and fields in the northern and eastern parts of the State.


Pasture Thistle.

The plant is very prickly, the heads are larger than in any other of our species, and amply furnished with good size prickles and large leafy bracts at the base, the leaves are very prickly, regularly scalloped, and the stem profusely branched. This species is readily exterminated by cutting off the whole plant before blooming, close below the crown of the root.

108. **Canada Thistle.** (B.) *Cnicus arvensis* (*L.*), *Hoffm.*

This most execrable weed that has yet invaded the farms of our country, is not a native of Canada as might be supposed from its common name, but of Europe, where even as long ago as the time of Linnaeus, the first systematic Botanist of the world, it was considered "Vitium agrorum apud nos primarium est" (the greatest pest of our fields.) The plant is slender, grows 1 to 3 feet high; has exceedingly prickly leaves, bears a large number of small rose-purple flower heads in clusters at the summits of its stem and branches, and is the lightest colored of all the thistles. This thistle is one of those particularly aggressive weeds that have the power of reproducing themselves from the root as well as from the seed, and on that account as well as the extreme vitality of the roots, it is very difficult to eradicate it when once it gains a footing.


Canada Thistle.

Its advent in this State was supposed to be brought about through the mediumship of baled hay brought in by federal troops during the war. Though this may, and probably does account for its presence in some localities, yet from Mr. McMurran's letter quoted below, it will be seen that it was known in Jefferson county at least, as early as 1840. In the western Pan Handle, it undoubtedly came by natural progression from south-western New York and western Pennsylvania. As to its distribution in the State, I have personally met with it in Jefferson, Randolph, Greenbrier, Brooke, Harrison and Monongalia counties; and have authentic

reports of its presence in Hancock, Ohio, Putnam, Lewis, Berkeley, Kanawha, Tyler, Upshur, Wood, Ritchie, Fayette, Preston, Grant, Hardy, Cabell, Clay and Doddridge counties.

To give our farmers some idea of what they will have to contend against if they do not now exert themselves to remove the comparatively small number of plants found growing in the State, I will quote the remarks of a few people from the thousands, who have looked with awe and dismay upon large areas of this most trying of weeds, and have delved in almost despair to rid their lands of its presence.

Prof. Seymour, of Wisconsin Experiment Station says: "The Canada thistle spreads locally by means of its running rootstocks. It may spread from a single plant and at length cover a whole field. In the heavy prairie soils of our Western States, it spreads more slowly than in the lighter, more sandy soils of the east, hence it is much less troublesome here. Cutting the rootstocks hastens the spreading, since it makes so many independent plants. Some of the pieces may be carried by the plow to a new place. Each piece grows with vigor, and thus for each break there is a new plant. Latent buds are forced into activity and new stems and leaves are formed."

"William Curtis, of London, gave the following account of an experiment with Canada Thistle or Field Thistle, as it is called in England, a hundred years ago: "I planted in a garden a piece of the root of this thistle, about the size of a goose quill, and two inches long, with a small head of leaves, cut off from the main root as it was springing out of the ground. This was done on the first of April; by the 2nd of November following, this small piece had thrown out shoots several of which had extended themselves to the distance of eight feet. Some had even thrown up leaves five feet from the original root. Most of the shoots were about six inches under ground. Others had penetrated to a depth of two and one half feet. The whole together, when dug up and washed from the earth, weighed four pounds. In the spring following it again made its appearance, on or about the spot from whence the original piece was dug. There were between fifty and sixty young heads, which must have sprung from the original planting that had eluded the gardner's search, though he was particularly careful in extracting them."

"To Mr. C. W. Palmer, of western New York," says the New York Tribune, "Much of the needful and beneficent discipline of life came in the common form of Canada Thistle in clover seed. Thus his farm became stocked thirty years since, with the worst of weeds. He tried many ways to get rid of them—mowing, hoeing, salting, etc.—but the plague multiplied until he had 'thistles in wheat, thistles in oats, thistles in corn, thistles in grass, thistles in everything raised.' But now his hundred acres of land, that 'five years ago was a complete mat of them' is wholly clear, the result of treatment carried on as follows: Plow the ground in June, drag twice in July and then gang-plough three times during August two or three inches deep, harrowing the ground every time. I plough

with a spring-tooth harrow, any tool that will cut off the tops the first, second and fourth weeks in August certainly uses them up here completely. No half way work will kill them. The tops must be cut off three times in August. A wet season is just as good as a dry one ; only do it and do it well."

Mr. J. C Plumb, of Wisconsin, had a little experience with this weed which was brought to him with a package of eastern trees ; he says: "We carefully cut, hoed and ploughed them for the next two years, a process which we found increased them from a square yard to a square rod. We then proceeded to clean off every tree and bush from the infested ground, and gave orders to every man and boy to watch that spot and not let a living plant show above ground. This was done so effectually, by looking it over once or twice a week the first summer, that only a trace of the plant was visible the next year, and before midsummer even they were utterly destroyed, never to reappear. Such, and such only, can we recommend as specific treatment for this pest of the farm."

Many of our own Agriculturists in this State have tried their hand and patience already in subdueing this weed, with what success the following letters will show: Mr. Joseph McMurran, of Shepherdstown, says : "The Canada Thistle can be found in this vicinity in great abundance, and delights in a moist, low, marly soil. It is next to impossible to eradicate it when it once gets a good hold, as I can testify to my sorrow. I have been familiar with it ever since my boyhood. The first I remember of the thistle was in 1840 when my father bought some Timothy seed in Georgetown and sowed it in a meadow along a stream running through his farm. The next year he had as fine a crop of Canada Thistle as was ever seen. Every effort was made to exterminate it, but in vain. It is there yet, and from its seed, it is probable that it spread over this region."

Mr. J. C. Miller, of Wellsburg, says : "We have here on our farm a patch of Canada Thistles about six years old. In the first place it contained probably from 400 to 500 stocks. We have been fighting it by digging it up and burning it every season, but still it continues to spread although we have never allowed it to go to seed. It has spread diligently from the root and can now be found from 75 to 100 yards from the original patch."

Mr. James W. Benner, of Leetown, says: "I have had a patch of Canada Thistle on my farm which I first noticed in 1874 as a small area not more than 3 ft. square. It has been spreading since then until it now covers about one sixteenth of an acre. I am salting it with a sack of ground alum salt and placing the land in clover. I shall plough under and sow in wheat this fall, hoping to thus get rid of the thistle." We shall look anxiously for the results of this treatment fearful that it will meet with no success.

I could quote from hundreds who have given their experience with this weed to the public, and could even give my own painful and extended trials with it, but that in the small space at my command in this bulletin, I have already given a good idea both of the plant and the best methods of attacking it; and will

conclude by saying that, were it not that Nature tends in two ways to thwart its growth, agriculture would speedily become the most laborious and least possible means of gaining a livelihood; and I could almost imagine that international famine would be the natural result of its rapidly spreading growth. These two controlling forces of Nature are: First, that the thistle is given a two formed existence, in that some plants produce good seed and others never can; second, that she has given it a preference for a heavy soil in which its eradication by man is most readily accomplished.

What emblem to commemorate the fall of Adam, the first Agriculturalist, could be more significant and appropiate than the Canada Thistle?

109. False Dandelion. (*P.*) *Krigia amplexicaulis* (*Michx.*) *Nutt.*

This is one of those wood-land plants that no one would have stopped to consider might have become a weed. It has generally kept close to its shaded haunts and moist banks, not venturing to spread into opens; yet along the river bottoms of the Little Kanawha, in Wood county, it is now becoming a weed in meadws and on pasture lands, scoring a point in aggressiveness that could hardly before have been credited to it. Its characters are: a bright yellow dandelion-like head on a long erect nearly naked flower stem, surrounded by several buds on shorter branches, and having a cluster of thin, almost entire leaves at the base.


False Dandelion.

This weed is not yet persistent enough in its new haunts, to withstand the hoe, which should be applied ceaselessly, whenever the plant is met with, to guard against its further development as a weed.

110. **CHICCORY.** (*P.*) *Cichorium Intybus*, *L.*

The Arabians not only initiated us in the use of a decoction of the fragrant and stimulating coffee bean as a beverage, but gave us its chief adulterant—the roasted root of this brilliantly blue astor-like plant—as well; which, being cultivated in various places for this purpose, has spread as a weed in many localities. Chiccory has a coarse, greatly branched growth from a deep root; beautitul double sky-blue flowers; and oblong, partly clasping, sharply cut, pointed leaves. As a weed in this State, I have met the plant only along the pike from Martinsburg to Shepherdstown. It should be prevented from spreading by the diligent use of the mattock yearly, before the flowering season, until it is eradicated.


Chiccory.

As regards the use of chiccory, Dickens, the English novelist, says in his "Household Words": "The great demand for chiccory has led to its very extensive cultivation in this country. * * * The bleached leaves are sometimes used as a sub-

stitute for endive, and are commonly sold as an early salad in the Netherlands. The roots, after being taken up and packed in sand in a dark cellar, with their crowns exposed, will push out shoots and provide through the winter a very delicate blanched salad. When chiccory is to be used for coffee, the roots are partly dried, cut into thin slices, roasted and ground. It has not, of course, the true coffee flavor, but it makes a rich and wholesome vegetable infusion of a dark color, with a bitterish, sweet taste, which would probably be preferred by a rude palate to the comparatively thin and weak, and at the same time not very palatable infusion of pure coffee of the second and third quality. By the combination of a little chiccory with coffee, the flavor of the coffee is not destroyed, but there is added to the infusion a richness of flavor and a depth of color a body which renders it to many people much more welcome as a beverage than pure coffee purchased at the same price." In times of scarcity chiccory certainly would make a better substitute than many other substances used, as, for instance, during the war of the Rebellion, beans, peas, rye, sweet potatoes, corn, cotton seed, peanuts, etc., were utilized.

111. **DANDELION**. (P.) *Taraxacum officinale. Web.*

There are so many much more unsightly and obnoxious weeds than this, that, with the exception of its destructive effects upon the appearance of village lawns and public parks, it is very little considered. This is one of the many plants of this family that Nature has exceptionally supplied with means of carrying its seed into new localities. Each head of fruits produces from 77 to 407 seeds, with the average—of one hundred counted—of 249; and each seed is provided with a feathery sail by which is sustained in moving air for long periods, whence it is finally dropped seed downward to the soil. The root is very tenacious of life rendering eradication of the plant well-nigh impossible in grass lands where cultivation is out of the question. Should, however, the plant become too numerous, then thorough cultivation for successive crops is the only measure that will rid the soil of it.

The leaves in early spring are much used as a pot herb and as such are very palatable. The leaves are eaten raw or cooked, by the Digger and Apache Indians who value them so highly that they scour the country for many days journey in search of sufficient to appease their appetite. So great is their love for the plant, that the quantity consumed by a single individual exceeds belief. In many parts of Europe, especially in Germany, the dried roots are roasted and substituted for coffee by the poorer inhabitants, who find that an infusion prepared in this way can hardly be distinguished from that of the coffee berry. Medicinally, in this State, the root is used in liver troubles (**25**, **188**); as a blood purifier (**11**); and as a diuretic in kidney affections (**21**, **103**, **104**, **111**, **124**, **181**).

112. SKELETON-WEED. NAKED WEED. HOG BITE. DEVIL'S GRASS. (P.) *Chondrilla juncea, L.*

This Old World weed is very little known in the United States except along the northern borders of our State, whence it extends into Virginia and Maryland. Although the distinction of growing this plant belongs almost wholly to us, we do not particularly pride ourselves in it as a production of our soil.

Skeleton Weed.

The common names of this plant as given by my correspondents more or less characterize its nature. It grows so rush-like, erect, and nearly destitute of leaves, that a clump of it has an appearance of striking nakedness not to be noticed in any other plant of our filds. This character, together with the prickly appearance of the stem near the root, and the copious milk that exudes from the stems when wounded, strikes one with the oddity of this plant, thus inviting questions by farmers as to its name and nature. Its naked stems clothed only with a few small, close growing, yellowing flowers, are principally found in Monongalia, Preston, Marion, Mineral, Hampshire, Berkeley and Jefferson counties, though one observer reports it as a new weed in Summers (80). A sufficiently wide distribution to warn us of its aggressive character.

The following notes from our observers will give further insight into the character of this plant: "Though a new weed to me and only commencing to scatter in this neighborhood, I find that the skeleton-weed is an old inhabitant here. I think that it will be hard to conquer, as its deep roots are very brittle and thus difficult to extract from the ground" (119). "The naked weed is gaining on our farms and proves difficult to eradicate" (274). "A very troublesome weed has made its appearance here (Monongalia) within the last three or four years, which I think promises to be the worst pest we have ever had" (10). A sample of the weed mentioned by this correspondent proved it to belong to this species.

For the eradication of this pest summer fallowing with frequent plowing and harrowing, succeeded by a hoed crop, will probably prove efficient. At the same time, the greatest care should be taken to rid roadsides and waste places of this plant by the determined use of the mattock before its seeds are ripe.

113. Wild Lettuce. Horse-weed. "Devil's Iron-weed." "Devil's Weed." (A. or B.) *Lactuca Canadensis, L.*

Growing particularly in fence rows but in fields, meadows,

waste places and along roadsides as well, this plant becomes one of

Wild Lettuce.

our most conspicuous weeds; especially so on account of its tall, very leafy and erect growth; its lettuce-like top; and its wide distribution. It is considered, and justly, a bad weed wherever found, and, notwithstanding the fondness that horses and cattle often exhibit for it (**172, 118**), its aggressiveness is looked upon with dread by most of our farmers.

It is mostly found on the richest parts of the farm, and is a great robber of the soil. The several species being mostly annual or biennial should, and will, yield to the scythe if persistently applied just before the flowers open. If cut too soon, a second crop will cause the work to be done over again. After cutting the plants should be carefully composted as they are very valuable as a manure, yielding a large quantity of nitrogen and potash.

The milky juice of these species is rich in a substance analagous to opium, which has been pointed out as a probable substitute for the commercial product. Although narcotic, this substance hardly deserves a tithe of the reputation held for it by some medical writers.

114. **SOW-THISTLE.** (A) *Sonchus oleraceus, L.*

Sow Thistle

A weed of our gardens, fields and waste places somewhat resembling in the character of its flowers the last species. It has, however, broader leaves which are less deeply incised and which partly clasp the stem by ear-like projections of the base; larger flowers, and a general color somewhat resembling that of the cabbage.

This weed is somewhat new on most of our lands, and should be kept from spreading by careful watchfulness and cutting the plants before the flowers expand.

BELLFLOWER FAMILY.

115. **Lobelia. Indian Tobacco. Wild Ipecac.** (A. or B.) *Lobelia inflata. L.*

This well-known medicinal herb of low branching growth with small blue flowers, and comparatively large inflated papery pods filled with minute blackish seeds, is almost a universal autumn

weed of our grass lands and road-sides. On newly cleared unploughed lands, sown to grass, it springs up luxuriantly (273) and particularly enjoys hillsides and fallows. The only method by which it can be eradicated is late summer fallowing with frequent use of the harrow, as set forth in part 4 of this bulletin.

This plant has been suspected of causing slobbering of horses, which it would certainly do did they eat of it, as it is very acrid and poisonous, especially in a fresh state. Some of our farmers believe that it actually kills many horse and cattle (273.)

In domestic and medical practice, the emetic properties of this plant have been well known since our first acquaintance with the American Indians, who used the plant for that and other purposes. In very small doses, it is used to check vomiting (134) according to a well known principle of medical practice.

Lobelia has been recommended and used, in Botanic practice particularly, either alone or compounded with other drugs for almost every disease known, and has proven curative in some cases, palliative in more, useless in many, and a deadly poison in more cases than one. Its action is, as in all narcotics, principally upon the brain, thus making it anything but a desirable emetic. From the power it exhibits to relax the whole system, it has been found very valuable in spasms, lock jaw, croup, whooping cough, and even hydrophobia. Samuel Thompson claims to have discovered the virtues of the plant, though without doubt his first ideas upon it were gathered from the Indians.

EBONY FAMILY.

116. Persimmon. Date plum. (P.) *Diospyros Virginiana, L.*

The persimmon is a very common and well-known tree in this State, and highly valued by some for its sweet fruits, which, though exceedingly astringent before being thoroughly frosted become pleasant and edible thereafter. In old fields and pastures, it often becomes quite troublesome from seeding in and sprouting where its presence is not desired. Fields in which this species and its associates become a nuisance should be cultivated and planted in successive crops as well as thoroughly fertilized.

Like many other plants and fruits containing much tannin, the fruit or bark of this tree is often used as an astringent in hemorrhages, and in catarrhal troubles of the upper air passages, and bowels.

MILK-WEED FAMILY.

117. "Rheumatism Weed." Indian Hemp.
Dog's Bane. (P.) *Apocynum androsaemifolium. L.*

This plant, known by its widely spreading habit, its reddish stems, small, pink flowers, milky juice, and peculiar curved cylin-


Indian Hemp.

drical pods growing in pairs and generally cohering by their tips; is a very common weed in meadows, pastures and old fields. As its seeds are of the parachute type, the plant should be grubbed out of such lands before its fruiting season, and composted with other refuse.

In domestic medicine, as well as in medical practice, this weed has gained considerable reputation when used in fresh decoction as a remedy for dropsy (**222**). Its use as a remedy in rheumatism is very extended in this State, either fresh (**42, 148, 182**), or preserved in whisky (**48**). It has also proved itself a good general tonic (**59, 60**), especially for dyspeptics (**200**), or where the liver is deranged (**73**), and constipation (**201**) results. It has also met with some use as a blood purifier (**114**); and a remedy for bronchial affections (**236**) and weak lungs (**236, 266**).

118. **Pleurisy-Root.** (P.) *Asclepias tuberosa, L.*

This is one of the most striking of our Eastern and Central meadow and hillside weeds, its bunches of flame colored flowers being very conspicuous and noticeable. The flowers bear a strong resemblance in shape to those of the next species; the leaves are, however, longer and narrower, as well as much more curled on the edges; the whole plant is roughish hairy; and the resulting pods hoary and erect, while the milky juice so prominent in the next species is entirely absent in this. This weed prefers a sandy soil, but takes kindly to our dry pastures and meadow lands as well, whence it should be grubbed 'ere the pods ripen their downy seeds and scatter them to the wind.

Pleurisy-root gains its name from its use as a remedy for bad colds and lung complaints (**239**.) "From the successful employment of the pleurisy-root for twenty-five years," says Dr. Benjamin Parker, "I have imbibed such confidence that I consider it to possess the peculiar and almost specific quality of acting on the organs of respiration, powerfully promoting suppressed expectoration, and thereby relieving the breathing of pleuritic patients in the most advanced stage of the disease; also in pneumonic fevers, recent colds, catarrhs, and diseases of the breast in general."

119. **Milk-weed. Silk-weed. "Wild Cotton."** (P.)
Asclepias Syriaca, L.

A common plant of our road-sides, pasture lands and meadows; is distinguished by its stout, milky stem, thick, light green leaves, and

Milk-Weed.

large, warty pods, with flatish tufted seeds. The milk-weed grows preferably in sandy soils, but like last species, does not scorn to grow upon our thinnest soils and hardest clays; from which it should be cut twice every season to guard against spreading its seeds; this treatment will also tend to kill the roots in due season.

Economically, the young sprouts form a delicious pot herb in early Spring, one that I personally much prefer to asparagus when cooked in a similar manner. The seeds form a soft and pleasant filling for beds and pillows in lieu of feathers (**142**.) In an old number of Tilloch's magazine, a memoir on the cultivation of this plant states its economic use in an early day: "Its chief uses were for beds, cloth, hats and paper. It was found that from eight to nine pounds of the coma of the seeds occupied a space of from five to six cubic feet, and were sufficient for a bed, coverlet, and pillows. The shortness of the fibre prevented it from being spun and woven alone: it, however, was mixed with flax, wool, etc., in certain stuffs to advantage. Hats made with it were very light and soft. The stalks afforded paper in every respect resembling that obtained from rags. The plant is easily propagated by seeds or slips. A plantation containing thirty thousand plants yielded from six to eight hundred pounds of coma."

The juice when applied to the skin forms a tough, adhesive pellicle; this has led to its use by the laity as a covering for ulcers and recent wounds to promote their healing; this milky juice is also stated to be an excellent curative application to parts afflicted by contact with the poison ivy (**55**). The plant has met with some use as a tonic in derangements of the stomach and liver, as well as a blood purifier (**178**); also as a remedy in simple fever (**267**); and as an astringent (**169**) and emmenagogue (**154**).

GENTIAN FAMILY.

120. **Centaury. Pink Bloom.** (A? or B.) *Sabbatia angularis* (*L.*), *Pursh.*

This plant with its 4-angled and winged stem; its egg-shaped partly clasping leaves; and its large cymes of rose-pink flowers at the summit of the stem and branches, is one of our most beautiful flowering species; that in our rich bottom lands and glady meadows shows quite a tendency to become a pernicious weed. It should be gathered yearly by the children to form bouquets for household ornament, thus preventing the plants from going to seed.

The roots make a deservedly popular bitter tonic, similar in action to the Southern Colombo.

PHLOX FAMILY.

121. **Wild Sweet William.** (P.) *Phlox maculata, L.*

Along the drainage ditches and other moist, rich spots of our farms, the tall, purple-spotted stems of this species surmounted by its pink-purple, sweet-william-like flowers form conspicuous masses of bright color. This plant shows some tendency, at least in Wirt and Gilmer counties to spread into the meadow lands, and for this reason should be watched and gathered for the compost heap, with the other trash of such places.

COMFREY FAMILY.

122. **Stick-seed. Dog-bur. Wool-matt.** (B.) *Cynoglossum sp.*

This family of plants produces a number of species whose seeds or fruits are provided with hooks or prickles by which they cling to the fur, fleece or hair of animals, and are thus facilitated in their distribution. Prominent among these is the species under consideration, and another closely related form known as Wild Comfrey (*C. Virginicum*).

Dog-bur.

The stock-seed illustrated here and in the plate accompanying the chapter on Weeds Injurious to Wool, is a softly-hairy leafy and bushy branching plant, with reddish or purple-brown flowers, bearing later in the season flatish nutlets armed with short rough spines. It is found along the roadsides, waste places and in pastures. This weed is particularly obnoxious, on account of the seeds becoming matted in the fleece of sheep and in the manes and tails of horses, and should be eradicated by means of the mattock before its fruits develop.

The plant is used in domestic practice much like Comfrey, as an application to sprains (**19**), and as a demulcent in lung troubles (**29**). It is also said to aid parturition in cows (**160**).

123. **Beggar's Lice. Stick-seed.** (A. or B.) *Lappula Virginica (Pluck.), Greene.*

A rough, hairy, greyish herb with small blue flowers, narrow leaves and seeds bearing a double row of anchor-like prickles on the margins. This weed has become rather common in some localities where its nutlets speedily become a nuisance to shepherds and stockmen. It should be carefully grubbed out wherever met.

124. **STONE-SEED. CORN GROMWELL. PUCCOON.** (A. or B.) *Lithospermum sp.*

Stone-seed.

This worthless, rough, hairy weed of our cultivated fields, with its red roots, erect stem, lance-shaped leaves, pale or greenish yellow flowers, and stone-like seeds; is as yet not particularly common in our State. To guard against its more extended presence, it should be handpulled before the fruits are ripe. Should a field be particularly infested with it, summer fallowing with persistent use of the harrow during August should completely rout it.

125. **BLUE THISTLE. BLUE-WEED. BLUE STEM.** (B.) *Echium Vulgare, L.*

Of all the weeds of this State, none is in more complete possession of the unused fields of its principal locality than this miserable and unsightly foreigner. I have seen fields in Jefferson county so blue with it that at a little distance they appeared as if covered with a fabric of that color. This condition also existed in that locality certainly as far back as 1841, for Prof. Asa Gray then wrote as follows in his account of a trip up the Valley of Virginia: "From the moment we entered the valley, we observed such immense quantities of Echium vulgare, that we were no longer surprised at the doubt expressed by Pursh whether it were really an introduced plant. This, 'vile foreign weed,' as Dr. Darlington, agriculturally speaking, terms this showy plant, is occasionally seen along the road side in the Northern States; but here, for the distance of more than a hundred miles, it has taken complete possession, even in many cultivated fields, especially where the limestone approaches the surface, presenting a broad expanse of brilliant blue. It is surprising that the farmers should allow a biennial like this so completely to overrun the land."

Blue Thistle.

A short description added to the illustration here given may be needed by farmers who live outside of the valley counties. Its flowers are deep blue, with buds varying from deep pink to purple upon the same plant; the hairs of the plant are stiff and stinging, requiring the use of gloves in handling it. It is an abundant seeder and bears flowers from early summer until the frosts of autumn. Blue Thistle makes an abundant and luxuriant growth, and will crowd out crops of oats or even of buckwheat. Outside of the valley counties, I have noticed this species in Randolph, Morgan, Mineral, Fayette, Kanawha, Greenbrier and Summers counties; and have authorative reports of its presence in Grant,

Tunker, Pendleton, Pocahontas, Mercer, McDowell, Lewis, Barbour, Webster, Doddridge, Wetzel, Marshall, Roane, Taylor, and Clay counties.

Where the plants are few, they should be pulled from the soil when wet and before the flowers have matured, and composted or burned. Too much time can not be spent in this work whether upon your own farm or the roadsides of your neighborhood.

The only reported medical use of this plant is that of the root in dropsy (**222**).

Where fields are given up to this weed, they should be deeply plowed and summer fallowed for one season, then sown to a hoed crop for at least one season thereafter.

MORNING GLORY FAMILY.

126. **WILD MORNING GLORY.** (A) *Ipomoea purpurea* (*L.*), Lam.

This beautiful climber so often cultivated as a lattice and porch covering, has become a pestilential weed in many of our western and southern counties; where it infests cornfields and crops of all kinds with its tangle of stems and branches. I have seen fields of corn in these districts so matted with its growth that it was difficult to distinguish even a leaf of the crop among those of the weed. "It is not so prevalent on hill farms; but on the river and creek bottoms, it is the farmers worst foe" (**31**).

When the plants are present but not yet too common, they should be cut down as soon as detected to prevent their flowering; if left until then, it may be too late, as the fruits are rapidly formed those of the earlier flowers being ripe while the floral succession is advancing. Lands infested with the weed must be summer fallowed with repeated harrowing until all starting vegetation is entirely scratched from the soil.

127. **Wild Sweet Potato.** (**P**) *Ipomoea pandurata* (*L.*), Meyer.

This weed is sometimes called "Man-of-the-earth" on account of the huge size of its root, which often grows nearly as large as a man's thigh. This herb has heart-shaped pointed leaves, twining or trailing stems, and large white morning glory-like flowers with purple in the tube. Wherever this plant grows, it is considered to be an obnoxious weed and one hard to exterminate on account of its deeply buried roots. In our heavier soils, however, it is much more readily dealt with than in the sandy or gravely soils of some sections. Thorough cultivation for two or three seasons is generally sufficient in the first instance; but in the second it is almost impossible to kill out an old growth of this plant.

Wild Sweet Potato

128. **Clover Dodder.** (A) *Cuscuta Trifolii*, Weihe.

A parasitic plant without roots or leaves, with yellow wire-like stems, and globular clusters of white tubular flowers.

Clover Dodder.

Only one report of this dreaded parasite so detrimental to clover fields has come to me in this State; that from Greenbrier county (**210**) where it was probably imported in clover seed from England, as this plant is a native of Europe and generally brought to this country in that manner.

Of this plant Mr. Coville says, in the Report of the Secretary of Agriculture, U. S. 1890: "The dodder seeds germinate in the ground, sending up slender leafless stems, which twine about the clover and obtain nourishment from it through the disks that are soon developed. The lower part of the stem then dies and connection with the ground is lost. The yellow threads continue to develop rapidly until a circular patch of clover is covered by it, and the host becomes so weakened by the loss of its sap that it finally turns brown, dies and rots.

The remedy is first to obtain a pure quality of clover seed. Dodder seeds are similar to those of clover, but of smaller size and capable of separation by screening. If a meadow is but slightly infested, each patch containing the parasite should be mowed and destroyed as soon as seen, and if no plants are allowed to seed, the clover will be saved. When, however, a meadow is thoroughly sprinkled with dodder, the whole must be plowed and other crops planted for a few years, when all the dodder seeds will have germinated and died. Under no circumstances should an infested crop be saved for seed."

129. **Dodder.** (A.) *Cuscuta Gronovii, Willd.*

This peculiar parasitic plant that twines about weeds and low herbage in damp places, may be said to resemble a tangled skein of orange red yarn. Should this plant (which, rather than a weed, is often an enemy of them) attack crops, the drainage proper to reclaim and render the lands upon which it is found more productive, would doubtless prevent its reappearance.

POTATO AND TOMATO FAMILY.

This family of mostly narcotic poisonous plants, such as henbane, tobacco, and belladonna; also furnishes us with some of our most useful vegetables: the potato, tomato and egg plant.

130. **Nightshade. Bitter Sweet.** (P.) *Solanum Dulcamara, L.*

This common dooryard and garden weed that often escapes to ditches, moist banks, and fertile fields is characterized by its

dark green arrowhead-shaped leaves and small blue flowers like those of the potato. Its fruit is a red, oval berry, very attractive to the eyes of children who are often tempted to eat them. The plant is sometimes known as "Deadly Nightshade," on the supposition that it is poisonous, which is probably true in some cases at least, as the following case of poisoning—reported in the Lancet—was undoubtedly from eating the berries of this species: A boy aged 4 ate of the berries, suffering no inconvenience until eleven hours thereafter, when he was attacked with purging and convulsions, followed by insensibility and death in about twenty-four hours. This should be sufficient to warn us that it is best to keep all trash from our farms by allowing no weed whatever to grow and ripen its fruit.

The leaves warmed in cream make an excellent curative application for poisoning by the poison vine.

131. **Common Nightshade** (A.) . *Solanum nigrum, L.*

This species differs from the last in having no ear-like lobes to its pointed egg-shaped and insect perforated leaves, and in its blackish berries. It is more poisonous than the last, as attested by the numerous fatal cases placed on record in various medical publications. In all these cases horrible convulsions continued until death relieved the sufferers. The tomato-like flowers and pendant egg-shaped berries should serve to distinguish these two species, which should never be allowed to go to fruit upon the farm.

132. **Sand Brier. Horse-nettle. "Radical."** (P.)

Solanum carolinense, L

This exceedingly pernicious weed is rapidly spreading throughout the State; apparently from the West and South-west portions, eastward and northward. It is characterized by its deep running roots; straggling, branching, half shrubby growth: its stems, branches and leaves thickly armed with sharp, stout, yellow thorns; blueish-white or blue potato-like flowers, and greenish-yellow globular berries filled with pulp and seeds.

Sand Briar.

I have met with this weed all along the Ohio River bottoms, and the lands bordering the rivers and streams flowing into it; beyond this, its most plentiful territory, I have met it in Calhoun, Wirt, Gilmer, Randolph, Webster, Nicholas, Greenbrier, Summers, Monroe, Fayette, Kanawha, Monongalia and Jefferson counties; and have authentic reports of its presence in every other county in the State. It is considered a new pest in localities in Greenbrier, (**223**), Upshur in 1888, (**238**), Barbour (**56**, **122**); Harrison, in 1889, (**275**), along the railroad tracks (**90**); Brooke (**193**), and in Doddridge (**163**) counties.

Although this weed prefers a sandy soil, and in such develops its greatest vigor, still there is no soil in the State in which it will not grow and thrive. It is so tenacious of life that it becomes almost impossible to get rid of it when it is once fully introduced in any given locality. I have met with it in such dense patches in pasture lands that cattle would not browse around it or pass through its formidable growth. In places where it is allowed to gain a good footing, it monopolizes the soil, and spreads its roots far and wide.

A special warning against this weed seems necessary, and were weed laws ever operative an especially stringent one should be enacted against this species; but as they are not, then let every farmer who sees this plant upon his land or roadside be a law unto himself and use his mattock skillfully; let him fight it as he would Satan and with as much courage and determination, for if he allows it to get the upper hand of him, woe be it unto his peace in the future. One of my correspondents says: that cutting three times a year will keep the weed under and prevent its spreading; but that one cutting has no material effect upon its growth or advancement. Where it is uncommon, each plant should be carefully dug up, and, if in fruit, burned. When it is prevalent, do not delay, but begin a rigorous course of summer fallowing; plow deeply as soon as possible in June, and harrow at least once every ten days until September; repeating this another season if necessary. If not, plant to a three year' succession of hoed crops 'ere you attempt to re-sod the the land for pasturage. This may seem a laborious and costly measure, but its results will amply pay, especially if the land is properly dressed with plaster and well rotted manure 'ere it is finally sown to grass.

133. **Ground-cherry.** (A. & P.) *Physalis sp.*

Our sandy roadsides and garden spots serve as good grounds in which several species grow and increase. They are generally characterized by their tomato-like growth and flowers; and their 2-celled red, yellow, orange, or greenish berries enclosed in an inflated "hull" or "pod," which is really the enlarged calyx of the flower. How pernicious these weeds may become is not yet known; it is therefore best to clear them all out before the fruits are matured.

The berries are claimed to be edible, but any such use of them is unnecessary, and might prove to bear ill effects. The plants are all diuretic and may prove efficient in some forms of kidney troubles.

134. Apple-of-Peru (A.) *Nicandra physaloides, (L.), Gaertn.*

This plant bears considerable resemblance to some species of the last, but differs in the nearly entire border of the blue flowers, and in its 3-5-celled dry berry. It is a weed of gardens and waste places from whence it should be cut and removed before fruiting.

135. **Jimson-weed. Jamestown-weed.**
Thorn Apple. (A.) *Datura Stramonium*, and *tatula*, *L.*

Who is not acquainted with the rank odorous growth of this common weed, with its funnel shaped flowers and thorny, egg-shaped pods! It is a prominent weed of waste grounds about dwellings, a character that plainly evidences the ease with which it can be exterminated by cultivation or cutting before the seeds are ripe.

Jimson Weed.

This is one of our most poisonous weeds, and should be eradicated upon that account if no other. It has met with considerable use as a domestic remedy for various troubles but should be given with great care. The leaves either alone or with those of the elder are often used to prevent or heal galls in horses by being placed under that portion of the harness that is causing the trouble (**98, 165, 284**); also as a poultice for bruises, sprains, and inflammations (**150, 277**) its action being anodyne in such cases (**104**). A salve made of the leaves steeped with lard (**60, 261**) is an excellent application for chapped hands (**204**), and for cuts and bruises (**48**). The dried root is often smoked as a remedy for asthma (**201, 252**).

The probability of this plant being a remedy for hydrophobia should be known in every household; I therefore quote the words of a Catholic Bishop of Singapore. This bishop says he thinks it his duty to publish, the remedies used in the missions of Tonquin for the cure of hydrophobia. These, he says, consist first, in giving as much star-aniseed as may be contained on a cent piece; and secondly, in making the patients take some water in which a handful of the leaves of the thorn apple have been infused. This will cause greater convulsions and delirium, during which the patient must be tied; but on the abatement of these, he will be cured. If the remedy acts too violently, either by too much being administered, or account of their being no virus of real hydrophobia, the consequences may be ameliorated by making the patient drink an infusion of licorice root, a most precious antedote against poisoning by stramonium.

MULLEIN FAMILY.

136. **Mullein.** (B) *Verbascum Thapsus, L.*

This tall velvety leaved plant with its dense spike of yellow flowers though not particularly common in our State threatens to become more so, and should be dug up with the mattock from all dry hillside pastures and other situations whenever met.

In domestic practice, the mullein has been widely used as a remedy for colds, (**4, 28, 67, 253**), coughs (**4, 27, 28, 39, 74, 88, 253, 271**), sore throat (**28**), lung troubles (**7, 105, 264**), and

even as a relief to the dry irritating cough of consumptives (**19**, **150**). A lotion of the leaves, or a poultice of the same is used for sprains (**205**, **249**), and chafing of animals, as well as for galls (**79**, **264**) and swollen joints (**37**, **184**); also as a remedy for piles (**160** **249**). The oil distilled from the flowers has been proven to be an excellent remedy for ear-ache when applied warm to the cavity of the ear. The velvety leaves applied and bound to a bleeding cut will staunch the flow promptly, even if severe.

137. **MOTH MULLEIN.** (B.) *Verbascum Blattaria, L.*

This tall, wand-like species, with its green nearly smooth leaves, and long spikes of scattered yellow or white flowers with a purple center; is prominent as a weed in many places, and should be grubbed out with the last species.

138. **WILD FLAX. DEVIL'S FLAX. WILD TOBACCO. INDIAN HEMP. IMPUDENT LAWYER.** (P.)

Linaria vulgaris, L.

This vile weed is rapidly tending to become a nuisance in many parts of the State and should be dealt with as rigidly as the Sand-briar or Canada thistle. It is characterized by its narrow, light green leaves, and its dense tip of yellow snapdragon-shaped flowers. The plant is not only reproduced by its abundance of light winged seed, but where once established spreads rapidly by long, slender underground root-stalks much like quack grass.

Wild Flax.

The following remark of Prof. Beal describes its progressive character: "Not far from the Agricultural College (of Michigan) twenty years ago, was a single patch in the roadside, not more than a rod square; now the weed is abundant in many places along that and other roads, and has established itself in generous patches on six or seven or more different farms, and on some of them it makes quite a prominent display, especially in old meadows and pastures The owners of these farms are just beginning to realize that they have a strong foe to contend with. Thorough cultivation with some suitable crop is the best and easiest remedy."

This weed prefers a dry soil, thus seeking our roadsides and hilly pastures, as well as banks and railroad beds. As the roots are very tenacious of life, watchfulness and frequent use of the mattock should be expended upon it wherever found.

139. **Gypsy-weed.** (P.) *Veronica officinalis, L.*

A low, hairy, creeping plant throwing up erect spikes of blue flowers, found mostly in open woodlands, though frequently in dry, hilly pastures and meadow lands. It will be found to be one of those weeds readily exterminated by renewal of the soil.

In some parts of the State, this plant is recommended for colds accompanied by cough (**73**.)

140. **Speedwell**. (A.) *Veronica serpyllifolia, L.*

This dainty little plant sends up in early spring its erect spikes of minute violet striped flowers from among the grass of lawns and meadows. It is of little moment to the farmer and simply mentioned here on account of its prevalence in some localities.

BIGNONIA FAMILY.

141. **Trumpet Creeper**. (P.) *Tecoma radicans, (L.), Juss.*

This common plant with its flaming clusters of tubular flowers, becomes a decided pest in some localities; especially, however, along the Ohio river and the large streams emptying therein. The plants should be cut close to the root, yearly, until they yield.

VERVAIN FAMILY.

142. **White Vervain.** (P) *Verbena urticifolia, L.*

White Vervain.

A weed of dry places, brookbeds, and waste grounds generally, characterized by its nettle-like leaves and numerous spikes of minute white flowers. This species is not as common with us as the next. When too common, and inclined to be a nuisance in pasture lands, they should be improved by thorough fertilization and cultivation.

This plant has some reputation in domestic practice as a remedy to break up fevers (**69**, **92**), in their early stages; as a quieting decoction in nervousness (**95**) and nervous sick headaches (**128**) as well as a remedy for looseness of the bowels (**221**), and amenorrhoea (**114**).

143. **Blue Vervain.** (P.) *Verbena hastata, L.*

This species grows in moister lands and better soils than the last from which it principally differs in bearing blue flowers instead of white. It should meet with the same treatment.

144. **Low Vervain**. (P.) *Verbena angustifolia, Michx.*

This small form with narrow leaves and a solitary or very few spikes of slightly larger flowers, is quite prevalent along roads, in dry fields and in pastures in Jefferson county. Cultivation will kill it out.

MINT FAMILY.

145. **Mint. Spearmint. Julep mint**. (P.) *Mentha viridis, L.*

This well known mint, though a native of Europe, is now very widely naturalized in wet places throughout our State; where

it grows profusely both from the seed and runner like offshoots of the root stock. Meadows affected by it can only be reclaimed by the drainage necessary to render them fertile.

The medical uses of this herb are much like those of the next species.

146. **PEPPERMINT.** (P.) *Mentha piperita, L.*

From being cultivated in this country for its aromatic odor and spiciness, this plant has escaped to moist, low grounds where it often spreads to considerable extent. It is distinguished from the last by its solitary, larger and more dense flower spikes, and its purplish stems.

This plant is cultivated for its oil, which is a well known remedy for stomach pains (**98**, **225**); neuralgias (**98**); nausea (**98**, **103**, **128**, **134**, **135**, **181**, **213**, **249**); colic (**157**); and colds with simple fever (**12**, **38**, **43**, **121**, **136**, **205**, **228**.)

147. **Mountain Mint** (P.) *Pycnanthemum flexuosum (Walt) B. S. P.*

One of the most frequent weeds in the south-eastern mountain section of the State; growing on all old fields and in waste places in general. It is an erect, branching herb, with small, very narrow leaves and small flowers arranged in clusters at the summit of the stem and upper branches. The general treatment given in part 4, for the renewal of old fields will, if followed, remove this species with the other filth of such places.

148. **Basil.** (P.) *Calamintha clinopodium, Benth.*

A low, erect, hairy plant, with egg-shaped nearly entire leaves, and pale purple flowers in globular clusters. This is a weed of borderlands that is spreading into fields and meadows. Its advancement should be checked by closer cultivation.

149. **Balm. Horse Balm. Wild Bergamont.** (P.) *Manarda fistulosa, L.*

This tall plant with its tufted heads of purplish dotted flowers, rigidly erect 4-angled stems, and egg-shaped, lance-like leaves; grows profusely in clumps along the bottom lands of the Kanawha and other rivers of our State. As a weed, it seeks fence rows, roadsides and other waste places of the farm, where it forms a very rank and unsightly herbage, and should be gathered in with the other weeds of such places early in July.

As a family remedy for causing perspiration in fevers, and colds, it is used in hot decoction (**43**, **97**, **113**, **199**, **154**); also in in this form for dysmenorrhœa (**154**, **135**); for looseness of the bowels (**155**) and as a diuretic in kidney troubles (**13**, **126**).

150. **Hairy Mint.** (P.) *Blephilia hirsuta, Benth.*

A tall, very hairy mint-like plant, with long stemmed leaves, heart-shaped at the base, and small pale blue purple spotted flowers crowded in the axils of the leaf stems. This weed often be-

comes a nuisance in damp meadows and pasture lands, and should be kept down with the other weeds of such places.

151. **CATNIP.** (P.) *Nepeta Cataria*, *L.*

Every one is acquainted with this pale green branching plant, with its scalloped leaves, and interrupted many-flowered clusteres around the tips of the branches. As a weed, it infests almost every dry-waste spot about the farmyard and garden. After gathering what is needed for the collection of herbs; the balance should be cut out annually to improve the appearance of the home surroundings.

In family medicine, a tea of this plant has a strong hold upon the housewife as a soothing draught for fretful babies (**12**, **204**); a queller of colic (**17**, **135**, **141**); a sweat producer in slight fevers (**97**, **228**); and in colds, (**2**. **16**, **43**, **45**, **67**, **115**, **156**).

152. **GILL. GROUND IVY.** (P.) *Nepeta hederacea* (*L.*), B. S. P.

Creeping extensively in gardens, orchards and damp shady places generally; this species with its dark green scalloped leaves and little blue-purple flowers becomes at times a serious nuisance (**69**), and should be hoed out diligently whenever it is a sufficient pest.

153. **Skullcap.** (P.) *Scutellaria lateriflora*, *L.*

This weed of moist lands may be known by its weak growth, square stem, egg-shaped toothed leaves, small, loose flower stems projecting from the point where the leaf stems join the stem, and its loose blue flowers. When troublesome, it shows that the land it infests is too moist for good crops and should be underdrained.

In domestic practice, the plant has some repute for nervous debility (**123**, **193**); for simple fever (**39**); to break up colds (**202**, **260**); as well as a blood purifier (**186**).

154. **Silky Skullcaps.** (P.) *Scutellaria canescens*, Nutt. / *Scutellaria saxatilis*, Riddell.

These two species bearing some resemblance to the last except in that the flowers are larger and are arranged in a dense panicle at the summit of the plant; inhabits drier grounds, pastures, and meadows, and in some sections near the Ohio river become very unsightly weeds. They should be cut down before their fruits form.

155. **Heal-all.** (P.) *Brunella vulgaris*, L.

This low mint-like plant with this dense, globular or cylindrical heads of deep blue flowers, may be found on all sorts of lands from which it should be cut or hoed out before going to seed. In an early day, this plant was used for all the troubles recorded under the different plants of this family; now however, it is seldom used at all.

156. **HOREHOUND.** (P.) *Marrubium vulgare*, L.

In many parts of the State, this bitter-aromatic plant has escaped and become a weed of considerable obnoxiousness. Its growth about the home for its medicinal use should be carefully kept within bounds by clipping off the flower heads before the fruits are ripe.

In domestic practice, this is one of the principal remedies for colds (4, 16, 45, 67, 73, 86, 115, 138, 163, 173, 175, 204); coughs (14, 79, 86, 94, 103, 138, 206, 227); fever (100); sore throat (45, 206); and lung troubles (121, 264). It is also often used in amenorrhœa and dysmenorrhœa (154).

157. **DEAD NETTLE.** (A or B.) *Lamium amplexicaule, L.*

In gardens and grass lands in many sections of the State this worthless little plant has become considerable of a nuisance and requires some attention to keep it hoed out 'ere it scatters its seed. It may be known by its clasping, scalloped leaves, square stem, and bright purple flowers.

PLANTAIN FAMILY.

158. **Common Plantain.** (P.) *Plantago Rugelii, Decne.*

This common and well known weed of the dooryard, garden, meadow and field, so persistently follows in the track of civilization that the Indians call it "White-man's Foot," believing that it springs up wherever a white man treads. Although so very common and general, it is not a particularly obnoxious weed, except on ornamental grounds and in dooryards, from whence it can only be eradicated by constant digging out of the roots before the fruits are formed. I have frequently noticed that cattle eat of it without distinction even when browsing in excellent grass.

This plant is said to be a good antedote for the effects of laurel on sheep (139); it also acts as an alterative and diuretic (123), and as a useful remedy for prolapsus in cattle (88). The leaves have been much extolled as a remedy for the bites of reptiles (41, 114), and insects (201). The fibrous stings of the leaf stems are said to be an excellent cure for toothache, if rolled in a ball and placed in the ear on the affected side. It is said that the ball turns black if the pain is relieved, but remains green if not.

159. **BUCK PLANTAIN. BUCKHORN PLANTAIN. RIPPLE. RIBWORT. ENGLISH PLANTAIN.** (P.)
Plantago lanceolata, L.

There a few of our farmers who have not become too intimately acquainted with this miserable European immigrant that

Buck Plantain.

seems to be striving, and with much success, to take complete possession of our grasslands. The leaves are narrow and ribbed and unless much crowded spread out flat upon the ground, thus tending to choke out the clover or grasses in which it grows. The seeds are of about the same diameter the shorter way as those of red clover, thus being very difficult to separate from them; it is for this reason more than any other that Ribwort is becoming so rapidly a very pernicious and aggressive weed. Ground is prepared for clover; these weed seeds are planted in it in the most efficient manner; thus giving them every chance in the world to grow and multiply. It is particularly on account of this weed that I write the chapter on "Weeds and Market Seeds" in part 4 of this bulletin.

Several of our farmers have already rightly mistrusted clover seed sown by them as being the agent of the introduction of this weed (**203**); correspondent **119** says, "Of late, the rib-wort plantain has taken complete possession of several clover fields in this locality; this has been growing more prominent for the last three years."

Where this weed has become very prevalent, the land should be summer fallowed and deeply harrowed at least three times in August; then put in a cultivated crop for at least two seasons longer 'ere returning to grass or clover. Now see that the seed sown is clean.

160. **White Plantain.** (A. or B.) *Plantago Virginica, L.*

This whitish wooly little plantain growing from 2 to 9 inches high with leaves ranging from egg-shape to lance-shape, and dense, hoary spikes of flowers and seeds, is mentioned as a weed in several parts of the State (**94**, **110**, **141**.) Mr. Prickett of Marion county, says of it: "I find this plantain growing on very thin sandy and rocky ground. The way it spreeds around makes me very fearful of it, and I am digging it up whenever I come across it." This is the proper measure against this weed, which is tending to become much more common annually.

AMARANTH FAMILY.

161. **Pig-weed.** (A.) *Amarantus sp.*

There are several species of this miserable garden and wayside weed, all of which bear more or less resemblance to the one here illustrated. They are all coarse annuals, with tufts of green or reddish minute flowers and bracts, either at the bases of the leaves or at the ends of the stems and branches. These weeds are all the natural result of careless gardening, as they would soon be eradicated if they were pulled up or even cut off with the hoe each year, instead of being allowed to go to seed as is usually the case.

162. **THORNY AMARANTH.** (A.) *Amarantus spinosus, L.*

Thorny Amaranth.

This species, introduced among our lands from tropical America, bids fair to become more of a pest in this State than all the other amaranths combined. It is distinguished from the others by its weaker growth and by the presence of spines at the junction of the leaves with the stem.

This plant is becoming a prominent feature of our waste places, gardens and fields; and should be cut out each season before it ripens its fruits.

GOOSEFOOT FAMILY.

163 **LAMB'S QUARTERS.** (A.) *Chenopodium album, L.*

This well known plant often called pig-weed like the last is distinguished by its light green foliage appearing as if dusted with flour, and its flowers being arranged in interrupted clusters about the ends of the stems and branches. It grows in waste places around dwellings, in barnyards, gardens, and even cultivated fields; whence its presence may be removed by a proper cutting off of all like trash twice yearly before they go to seed.

Lamb's Quarters.

The young and tender plants of the lamb's quarter, says Mr. J. R. Dodge, "are collected by the Navajoes, the Pueblo Indians of New Mexico, all the tribes of Arizona, the Diggers of California, and the Utahs, and boiled as herbs alone, or with other food. Large quantities are also eaten in the raw state. The seeds of this plant are gathered by many tribes, dried, ground into flour, and made into bread or mush. They are very small, of a gray color, and not unpleasant when eaten raw. The peculiar color of the flower imparts to the bread a very dirty look and when baked in ashes it is not improved in appearance. It resembles buckwheat in color and taste and is regarded as equally nutritious.

164. **WORM-SEED.** (A.) *Chenopodium ambrosoides, var. anthelminticum, (L.), Gray.*

Another member of this family noted for its strongly aromatic odor, and worm expelling properties. Its lower leaves are strongly toothed, the upper lance-shaped and entire; its flowers are little, bud-like growths clustered irregularly along stems projecting from

the axils of the leaves. This weed should be attended to at the same time and in the same manner as the last two species.

Its principal domestic use has been that of the leaves and seeds as a vermifuge for which it is considered one of the best known. The leaves steeped in vinegar make an excellent application for sprains, bruises, and local inflamations.

POKEWEED FAMILY.

165. **Poke-weed.** (P.) *Phytolacca decandra*, L.

This well known rank, red-stemmed and berried weed is useful in many ways, but especially when grubbed out of our farm lands, composted and returned thereto, as it shows the highest manurial value of any weed yet analysed (see page 123 part 1). The poke is one of our particularly troublesome weeds and should be grubbed up and composted annually before its fruits are formed; it will pay the farmer several times the value of the time so expended upon it. "Sheep eat the berries and leave the seed on the high points of their pasture where they lie at night. Some of our knolls thus become so thickly set with the plant that it kills out the grass. Cutting will not kill them on account of their large deep succulent roots." (**121**) Many species of birds are also fond of the fruit, and as many of the seeds pass them uninjured, they tend to distribute the weed widely if it is allowed to go to fruit.

Economically, the berries yield a magenta stain much used to dye the handles of cheap household utensils, as well as the rind of Edam cheese. I understand that the berries have been used by frugal housewives in the construction of pies, and have often half determined to try poke berry pastry myself; discretion has, however, always overruled my valor.

The medical uses of poke root were handed down to domestic aud botanic practice by the Indians, who valued the plant not only as an emetic, but also as an efficient remedy in some forms of rheumatism. Poke root is recommended in veterinary medicine as a remedy for hog cholera (**91**.); Murain (**37, 148**); hollow horn (**98**); as a tonic appetiser (**132**); for scouring of horses (**132**), and as a poultice for caking and inflamation of the bag. In domestic practice the root is used internally, either alone or in whiskey, for rheumatism (**122, 123, 205, 264**), or externally with turpentine (**98**). It is also given in some cases of sore throat (**110**), and recommended as an excellent poultice for suppurating glands (**14, 69**).

BUCKWHAET FAMILY.

166. **Yellow Dock. Curled Dock.** (P.) *Rumex crispus*, *L.*

The illustrations here given will serve as a method for distinguishing this and the next species from each other. The yellow


Yellow Dock.

dock may be recognized by its narrower leaves curled at the margin, and by its denser spikes of larger fruits. Both species have large, deep roots very difficult to extract from the soil. They grow in the garden, yard, meadow, pasture, and waste spots of the farm; giving it a very unsightly and negligent appearance. They should be grubbed up annually and composted before the fruits are ripe. Persistence in this will in time rid lands of the pest.

The young root-leaves gathered in early spring form a well known pot-herb. The root has been used much like Turkey rhubarb for a tonic and alterative (**104**, **204**); in jaundice (**252**); and with the next species as a blood purifier. A salve made of the root with lard or with cream is a well known application for the cure of itch (**37**, **160**). The root is also used for sore mouth (**189**).

167. **BITTER DOCK.** (P.) *Rumex obtusifolius, L.*


Bitter Dock.

This dock differs from the last in its broader and blunt leaves not curled on the edges; its less dense and smaller seeding panicles; and its more branching dark root, on which account, it is much harder to extract from the soil than the last, and luckily is also less prevalent. Remember in fighting these plants to anticipate the maturing of the seed by getting the docks out of the ground and into the compost heap before the last of July. Do not pull them up and leave them on the ground, as the roots store up sufficient vitality to mature the seed after they are out of the ground.

Bitter dock has proven itself to be tonic, alterative and cathartic, for which properties it is often used as a blood purifier (**4**, **14**, **15**, **57**, **66**, **69**, **94**, **213**, **220**.)

168. **HORSE SORREL. RED SORREL.** "Red-weed." (P.) *Rumex acetosella, L.*

Little need be said in the way of description of this dock to

Horse Sorrel.

those who are but too well acquainted with "Red Lands," as thin illy-nourished fields are called when this weed has taken full possession as it often does, in such cases vieing with cinquefoil for the honor of complete ascendency. We can not properly say in such cases that it kills out the grass; the better way of looking at the matter is that the land, though good enough for sorrel is not good enough for grass. Sorrel will, however, grow also in land that has been more or less properly prepared for forage plants or crops; in which cases, it has been known to choke out both wheat and clover (**172, 178.**)

The following account of the weed by the Hon. Thomas Laurence, and Prof. W. M. Van-Sickle, of Sussex county, New Jersey, gives an idea of some of the influences that work for and against the soil: "Enriched soil is not the natural home of the sorrel. On sandy, gravelly hills the plant seems to thrive at its best and is frequently an index of a soil not being able to bear profitable crops without manure or fertilizer. Climate is a ruling power. During the excessively dry seasons of a few years ago, farmers experienced no little difficulty in getting grass seeds to take. Hundreds of bushels of clover and timothy seeds were sown on the fertile fields of Sussex without any return for the work. But sorrel came and flourished. In many fields it was the abundant crop of the time. It could not be driven away. Year after year it made its appearance on hill and dale. Farmers grumbled and complained, but still the sorrel came. The dryless seasons of the past two summers have thrown a wet blanket upon the face of the earth, from which has sprung forth an abundant crop of grasses, crowding out the sorrel from its abiding place."

From what has gone before, it might be judged that the best method of eradicating this omnipresent weed is to prepare old pasture lands thoroughly during a wet season, and sow plentifully with plaster and clean pasture grass seed (not hayseed from a mow), roll it as carefully as you would grain, then give it a good chance to get a thorough stand before mowing or pasturing. This procedure should give the grass a better chance than the sorrel, thus changing the nature of things, making grass the enemy of sorrel instead of the opposite.

169. **Smartweed.** (A. & P.) *Polygonum sp.*

There are a large number of species of smartweed in the State, most of which prefer a moist soil, where they flourish to the exclusion of most other forms of vegetation. They are characterized by their long, lance-shaped leaves, sheathed and jointed stems, and spikes of pinkish flowers. Some of the plants, especially those with nearly white flowers, bristle-fringed sheaths, and a dark patch near the center of the leaves, are noted for their hot, peppery taste;

it is these forms that are ususually gathered for medicinal purposes. Renewal of fields affected by them, with under-drainage when too moist, will be ample protection for those who adopt the measure.

In family practice, the species known as "water-pepper" is most generally used. The fresh leaves bruised with those of the dog's fennel, to which is added a few drops of turpentine, form a promptly acting blister. A strong decoction of the fresh plant will produce perspiration in simple colds and fevers (**258**); and prove useful in some forms of colic (**154**). It is also an excellent remedy for cholera morbus (**124**), as well as for heaves in horses. A cold infusion has been found useful in nursing sore mouth, mercurial salivation, gout, dysentery, and externally as a wash for slow healing wounds and ulcers.

170. **Climbing Buckwheat.** (P.) *Polygonum dumetorum, var. scandens* (*L.*), Gray.

Climbing over low herbage and shrubbery about damp places and forming a dense tangle, this species will be readily recognized by its heart-shaped, light green leaves, and its long, drooping clusters of greenish white fruit. It is a profuse seeder and should be removed from the places it habits not only by gathering it all in before the fruits are ripe but by removing the useless shrubbery and draining off the ground on which it grows. This means the clearing out of all such places and rendering the land hitherto useless, profitable.

SPURGE FAMILY.

171. **Flowering Spurge.** (P.) *Euphorbia corollata, L.*

An erect, straight stemmed plant branching only at the summit, with close growing, entire egg-shaped leaves, and small white flowers disposed in an umbrella-like branching cluster at the summit of the plant and milky juice. This species is very common in meadows along roadsides and opens generally, especially in our central counties. As all species of this family are more or less acrid, it is well to use every means possible to prevent them from ripening and scattering their seeds, which they are particularly fitted to do by the bursting of their elastic pods.

Flowering Spurge.

The root of this species is a very good emetic, and has often been substituted for commercial ipecac. The powdered root is said to be emetic in 20, cathartic in 10, and diaphoretic in 4 grain doses.

172. **Spurge.** (A.) *Euphorbia Preslii, Guss.*

An erect or inclining very branchy herb, with reddish green

stems and branches, small egg-shaped leaves, oblique at the base and often red on the margin, and inconspicuous white or reddish flowers. This species grows usually on dry soils, yet I have met with it in rich meadow lands where it often grows in very large patches. On account of the acrid juice of this plant, it is credited with causing sore eyes and slabbering in cattle; this may be true as it has a particular action in that direction. Every means should be employed to prevent the plant from seeding. It should be cut as early in the season as possible and taken directly to the compost heap or the fire.

The plant is recommended in diarrhœa, leucorrhœa, and gonorrhœa. A half ounce of the dry leaves should be infused in a pint of boiling water and a tablespoonful taken before meals.

173. **Three-seeded Mercury.** (A.) *Acalypha Virginica, L.*

A common garden and dooryard weed noticeable from its tendency to turn purple or bright red after its flowering season has passed. This weed has no particular feature by which one not versed in plant characters might readily recognize it; to those, however, who keep all weedy trash out of their gardens and yards, it will not be much cause of annoyance.

NETTLE FAMILY.

174. **Nettle.** (P.) *Urtica gracillis, Ait.*

The common nettle whose character is too well known to every one by experience, is an inhabitant of damp shady places (one species) and of waste places and roadsides. It is known by its deeply toothed, egg-shaped leaves and its clusters of small, yellowish-green flowers. The species that grows in damp places will yield with other trash by drainage; that of the roadside should be cut out annually until conquered.

The root of the nettle is a well known remedy for mumps (**160**); and often proves beneficial in hives (**103,105**). The most ancient use of the nettle was flagellation, a practice of whipping paralyzed limbs with the plant, to bring the muscles into action. This practice extended also to a stimulation of impotent organs and to bring into action dormant energies. It was also resorted to in apoplexy and heavy congestions to bring the blood to the surface and thus relieve the more vital organs; in eruptive fevers, to bring out the eruption; and for various affections where a powerful irritation of the skin was considered necessary. For this the European Stinging Nettle (*Urtica urens, L*), a plant that is becoming introduced as a weed in some parts of Hancock county, is most frequently used, as it has a more severe sting.

175. **Rich-weed. Clear-weed.** (A.) *Pilea pumila (L.), Gray.*

This weed of damp places is known by its thick, juicy, transparent stem and large thin coarsely toothed pointed leaves. It

grows in moist, cool, shaded spots, whence it should be removed by clearing out all such places on the farm.

The root has been used for gravel (139); but the most common use of the plant is that of the stems and leaves as a cooling application to inflamed places, and as a remedy for piles.

WILLOW FAMILY.

176. **White Poplar.** (P.) *Populus alba, L.*

The White Poplar is known by its greenish-white trunk and branches, and its leaves being silvery beneath. It is often cultivated for ornamental purposes about home grounds and in public places. This use of the tree is productive, however, of great labor on our stiff lands, as its roots creep far and wide close to the surface of the ground and send up leafy sprouts in all directions, thus becoming weeds of very obtrusive and unpleasant character. Do not plant the tree where lawns are to be kept up; and if planted elsewhere, keep the sprouts out as fast as they appear, to save multiplied labor later on.

LILY FAMILY.

177. **Greenbriar.** (P.) *Smilax sp.*

These shrubby, usually climbing plants, several of which are amply provided with thorns, are well known weeds in this State, so much so in fact that one of our finest counties takes its name from their extended presence therein. The leaves of all species are shiny, plainly ribbed, netted veined, and the fruit a small blackish berry growing in clusters. The only method of subjugation is to grub out thoroughly all places infested with it, and place the lands for a time at least in well fertilized, cultivated crops.

178. **Field Garlic.** (A or B.) *Allium vinale, L.*

This pest of the wheat fields in the valley counties, and the pastures of many parts of the State, is supposed to have been brought to this country by some Welch immigrants to Pennsylvania, who planted it for early pasturage in their neighborhood. The presence of the little bulbs of this plant in wheat destroys the flour made therefrom; and pasturage infested with the plant ruins the milk and butter produced. The only way to get rid of the weed in lands infested by it is thorough tillage through a series of well fertilized and cultivated crops.

179. **Day Lily. "Eve's Thread."** (P.)
Hæmerocallis fulva, L.

This well-known white garden lily often becomes a great nuisance by escaping to fields, meadows and cultivated lands where plowing often scatters it far and wide on account of its roots being very tenacious of life. Where it has once made its inroads, very

thorough and watchful grubbing and removal of the roots to the compost heap only will subdue it.

180. **Wild Lily. "Glade Lily."** (P.)
Lilium Philadelphicum, L.

In our glade regious, this beautiful orange-red lily with purple spots in the throat, is a very common weed. It is also an inhabitant of dry fields, especially if sandy. This plant is an old field weed, however, and will seldom hold out against cultivation, which is the best method of eradicating it.

RUSH FAMILY.

A family of grass-like plants with hollow stems, and small heads of minute flowers.

181. **Poverty Grass.** (P.) *Juncus tenuis, Willd.*

Poverty Grass.

Growing thickly along roadsides, in fields, and many old meadows, this grass-like plant causes much comment among those who judge it to be a grass, yet one upon which cattle grow poor and almost starve. The leaves of this species will be found upon close examination to be tubular and very different from those of any known grass.

This species grows in damp places, and though it will yield to cultivation where the ground is not too moist, it generally shows by its presence that drainage is necessary. This measure properly carried out will kill out the weed.

182. **Wood Rush.** (P.) *Luzula campestris (L.), DC.*

On dry fields and borders as well as in opens, this species, with its flat grass-like leaves is often mistaken for some strange grass with peculiar straw-colored flowers. It is, however, a rush and of very little nutritive quality, and should be grubbed out or the fields renewed and put in cultivation until such plants yield.

CALLA FAMILY.

183. **Skunk's Cabbage.** (P.) *Spathyema foetida (L.), Raf.*

This peculiar cabbage-like plant of low lands and wet meadows, the bruised leaves of which emit an odor strongly reminding one of the animal from which it has received its common name, throws up its peculiar purple calla-like flower in early spring, which is soon followed by the rapid growth of its immense leaves. The roots are large and deep, and the low growth of the spreading leaves crowds out everything in the vegetable line that grows near it. The plants should be grubbed out annually until they are conquered, un-

less the quantity of the growth is too great for such a measure, in which case, drainage should be resorted to, as these plants can not live without more moisture than is needed by grasses or crops.

The roots have long been known to form an excellent poultice when mashed and mixed with corn meal, for reducing the hardness and inflamation of caked breasts. The leaves are said to draw out the poison when applied to places bitten or stung by reptiles or insects (**4**). The juice of the root is also said to be a soothing medicine in consumption (**160**).

SEDGE FAMILY.

184. **Galingale.** (A. or P.) *Cyperus sp.*

Galingale.

Plants of low moist ground and ditches characterized by their grass-like leaves and terminal branching clusters of peculiar flattish cheat-like fruits on cylindrical or triangular stems. These are all plants of low grounds, which can only be cleared of them with profit by proper underdrainage.

185. **Poverty Grass.** (P.) *Eleocharis tenuis (Willd.), Schult.*

Another rush-like form quite similar in general appearace to weed 181, but with harsher leafless scapes surmounted by very small purplish heads of minute flowers, the whole springing from a matted running root stalk. The treatment of lands infested with this weed should be the same as that for 181.

186. **Bulrush.** (P.) *Scirpus, sp.*

Bulrush.

The Bulrush is a well known form in this family growing in clumps in wet meadows and along runs where good grass can not thrive. Locations infested with this weed need thorough drainage. The only measure through which such lands could possibly be rendered profitable, and one which will kill out all of the weeds growing thereon.

187. **Sedges.** (P.) *Carex sp.*

Sedge.

There are a large number of plants of this group, all characterized by their grass-like growth and more or less stiff heads of scale-like flowers springing from the side or summit of the mostly triangular culms. The leaves are generally sharp on the margin and keel, giving them more or less of a cutting edge. They are all useless as fodder for stock; and fields infested with them should be renewed through a series of well fertilized and cultivated crops.

GRASS FAMILY.

188. **Tickle Grass. Old Witch-grass.** (A.)
Panicum capillare, L.

This well-known and worthless grass flourishes in our driest and sandiest fields, as well as in corn lands, where at the end of the season the stems are broken off by the wind and the fruiting heads rolled along the ground scattering their seed as they go until they are finally collected in great numbers along the fence rows. Where this grass is plentiful, it should be prevented from going to seed by changing the crop amongst which it grows to one that will remove it through late cultivation.

189. **Crab Grass.** (A.) *Panicum sauguinale, L.*
This is one of our richest and most nutritious grasses, and at the same time one of the most troublesome weeds in gardens and fields requiring high cultivation. The running and re-rooting stems and tufts of firmly anchored leaves are very difficult to pass the cultivator through if tillage is delayed. Lands infested with it should be cultivated frequently and this grass gathered and carted to the compost heap as frequently as possible, allowing none to go to seed.
According to the analysis of our chemist, this grass yields of:

Moisture	6.79
Ether extract	3.12
Fibre	29.72
Ash	10.15
Crude Protein	11.03
Nitrogen free ext.	39.97

Thus giving the high nutritive ratio of 1:4.26. When composted, its value as a fertilizer is also high as may be seen by referring to the table given in part I. of this bulletin.

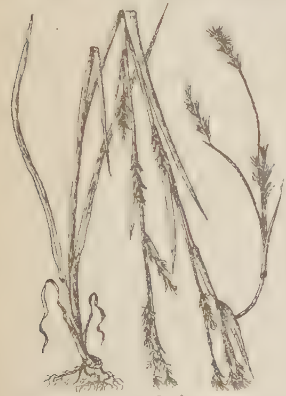
190. **FOX-TAIL GRASS.** (A.) *Setaria glauca* (*L.*), *Beauv.*

This is the commonest late grass of wheat stubble and corn lands, known by its yellowish barbed heads and the profusion of its leaves. This grass, though rich in nutritive fodder qualities and relished by cattle before it goes to seed, is mostly considered a weed from its habit and choice of locality. The probable reason why cattle will not eat of this grass after it has headed out is on account of the sharply barbed awns which are said to often cause serious inflamation of the stomach. Poultry enjoy stripping the fruits from the heads, and should be allowed to carry out their good offices in this regard. The only profitable way to rid meadows and pasture lands of this weed is to fertilize them thoroughly and sow plentifully with early growing grasses that will make a good stand before July, thus choking out the Fox-tail.


Fox-tail.

191. **Broom Sedge.** (P.) *Andropogon scoparius*, *Michx.*

This miserable weed is becoming such a grave pest on our lands that methods of extermination will have to be rigorously adopted to save many pastures and meadows from absolute ruin. In many places in the South, this grass is cultivated for pasturage and hay; though I can not as yet see wherein we can utilize the plant on the soils of this State. With us, Broom Sedge is a poor fodder and only eaten by cattle and sheep while it is young and tender (238). However, as there is still a question, and as we have as yet had no opportunity to test the matter, I will quote at length two articles that cover the whole subject, and leave it to our farmers to decide which is the truest of their own conditions, and will serve their farms best.


Broom Sedge.

Mr. W W. Hobson, in the Southern Planter, 1892, page 3, says: "Since I have turned my attention to live stock, and that very great pest, Broom Sedge, would come up in my grass fields, I commenced grubbing it out, but soon found this useless, as it was too formidable an enemy for me to contend with.

"My clover, timothy and herd grass fields were rapidly being taken by the Broom Sedge. When I was mowing the grasses, I had therefore to mow the Broom Sedge also, and this being made into hay, I watched to see how my animals liked it. Putting the clover, timothy and herds grass in the racks with the Broom Sedge, to my surprise I found the Broom Sedge was the first eaten. Now I am trying different experiments to ascertain the best way to keep the Broom Sedge fields in the best condition for hay, as nearly all the other grasses have disappeared. The Broom Sedge can be

mowed twice the same year, say last of June and then about the 15th of September. I have now one field which I have mowed the second time this year, and another field once mowed, now in very heavy growth, which I contemplate burning in order to see which is the best course.

"The great secret of making hay from Broom Sedge is: to cut at the right time, and that time is about the last of June or the first of July, just as the stem starts up, It is very tender, and should be carefully cured, never allowing the sun to burn it. To do this, I keep my rake very close to the mower; and now I am decidedly of the opinion, and that based on several years' observation, that the once considered pest, will prove to be my very best friend, and will be in the near future, the great source from which our hay is to be gotten in Eastern Virginia."

Notwithstanding the words of Mr. Hobson, I am of the opinion that it will be a poor policy to cultivate Broom Sedge for hay when much more nutritious grasses can be grown upon the same soil, with the same care and fertilization, and will result in less wear on the animal economy.

Prof. Massey, in the same Journal, page 71, says: "Broom Sedge, no doubt, has been the salvation of large areas of land in all parts of the South, which, but for its friendly cover, would have washed away to utter barrenness; but that it should be cared for as a hay crop in a country like Piedmont, Virginia, when it is so easy to get the land into the growing of better grasses, is something I never dreamed any one would advocate. Some varieties of Broom Sedge in a young state are really good pasture for awhile, particularly for milch cows, but others are never good. People speak usually of Broomsedge as one species of grass, while the fact is that there are in Virginia and North Carolina many species of this Andropogon. The tall growing sort, of which our country people make brooms, is never worth much for food for stock, while the shorter species, which abound in the uplands of the Piedmont country, are very palatable in the young state. When a man has more land than he can properly cultivate, and can not readily sell it, there is some excuse for outlying pastures of broomsedge, but the hay that can be cut from such lands must be scanty in quantity and hardly worth the labor of saving if a man has any cultivated grasses to attend to. I think that Mr. Hobson will find little trouble from broomsedge by adopting a shorter rotation, breaking his soil and liming well at least once in five years. On all the uplands of Virginia, east of the Blue Ridge, broomsedge will get the advantage if the lands lie in mowing or pasture too long without lime; not that lime is a specific cure for sedge, but used in connection with the buried sod, it produces conditions in the soil favroable to a dense growth of the better grasses, which easily choke down sedge until they become enfeebled. If these uplands are deeply plowed and subsoiled when the sod is broken, no disastrous washing will take place before they can be gotten back into grass again. Shal-

low, skim plowing, is responsible for more gullies on the Virginia hills than anything else."

Little more need be said of methods for killing out broomsedge than that embodied in Prof. Massey's article. Where but little of the sedge is present, however, grub it out before it ripens its feathery seed.

192. **WILD OAT GRASS.** (P.) *Arrhenatherum elatius* (*L.*), M. & K.

This tall grass is rapidly supplanting the better species in many parts of Monongalia county greatly to the detriment of our orchards and meadows. Our analysis shows it to yield of:


Wild Oat Grass.

Moisture	11.06
Ether Extract	3.21
Fibre	34.64
Ash	4.29
Crude Protein	4.61
Nitrogen free extract	42.19

which proves the nutritive ratio of this grass to be very low: only 1 : 10.88.

"This species is much valued on the continent of Europe for the food of all animals except horses. The herbage is very productive, very early, and rapid in its growth. When growing with other grasses, cattle and sheep eat it very well, but do not like to be confined to it alone."

193. **"OLD WHITE-TOP." "FEATHER GRASS." "VELVET GRASS."** (P.) *Holcus lanatus, L.*

Although considered an excellent hay crop in some parts of the South, with us it grows in high clumpy tufts disfiguring not only the field but the surface level as well. Our analysis of the species gives it of:


Old White-top.

Moisture	10.34
Ether Extract	1.42
Fibre	33.01
Ash	6.64
Crude Protein	7.30
Nitrogen free extract	41.29

and a nutritive ratio of 1 : 6.12; making a very fair showing as a fodder. It may make a very good early hay crop when sown alone for this purpose, but when existing with other grasses, it ripens so early that it is absolutely worthless when the other hay is ready for the machine. It is well to grub it out as it appears to prevent its seeding in when not desired.

194. **DOG'S-TAIL GRASS. WIRE GRASS.** (P.) *Eleusine Indica* (*L.*), Gaertn.

This peculiar five finger grass of the walk, garden, lawn and

street is a bad weed to contend against and should be hoed out scrupulously whenever noticed. While it is fully as difficult to eradicate as crab grass, it is of much less use to the cultivator of the soil. Kill it out with the hoe before it seeds.

195. **Eragrostis.** (P.) *Eragrostis hypnoides* (*Lam.*), B. S. P.
This grass becomes a weed of the dry pasture and sandy roadside, and is obtrusive wherever it habits. It should be gathered with other trash and composted.

196. **CHEAT GRASS. CHESS.** (P.) *Bromus sp.*


Cheat.

This is a common group of grasses well known to all farmers from their resemblance to degenerated wheat, which in fact, many believe them to be. They bear no relation whatever to wheat (except mayhap to the stubble field) either in appearance or usefulness, and should be treated as weeds which they really are. The best method of subduing them is; First, a high culture; Second, a careful preparation and fertilization of the soil; and third, sowing of pure seeds.

197. **DARNEL. ENGLISH BLUE GRASS.** (P.) *Lolium perenne, L.*


Darnel

Although this grass is called English Blue Grass here, and often sold as a superior grass for lawns and meadows, it does not prove as valuable as many claim, and should not be purchased for use here where other well known nutritious grasses are so plenty. We should be sure at least, if we desire to try this new species, that the variety known as Italian Rye Grass is furnished. In meadows and especially lawn mixtures, it is well to avoid this species, replacing it with that much more white clover and blue grass.

198. **Horse-tail.** (P) *Equisetum arvense, L.*
Standing erect in the grass of low places in early Spring, many of the little arrow-like stalks and yellow heads of this peculiar plant may be seen, followed later by a green feathery herbage looking something like the scraggly tail of an old horse. These plants

are useless to the farmer and should be replaced by good grass. This may be accomplished by underdraining such places as are too much given to this weed.

FERN FAMILY.

199. **Brake Fern.** (P) *Pteris aquilina, L.*

In many hillside pastures and meadows, large patches of this fern grow, affording a cover for rattlesnakes and choking out grass and other herbage. Such places should be cleared out by early grubbing followed by fertilization, and plentiful seed of some rapid growing grass.

The young sprouts which are curled like a shepherd's crook make an excellent pot herb in early spring.

MOON-WORT FAMILY.

200. **Moon-wort.** (P.) *Botrychium ternatum var. bliqumo* (*Muhl.*), Willd.

In old fields, meadows and pastures, this one-stemmed "fern" with a brown fruiting summit often becomes quite noticeable as a weed. It is not of sufficient importance to need particular attention except when growing in quantities, in which case, it is an indication that the field needs renewal.

CLASSIFICATION SUMMARY

	1st. Class Worst.	2nd. Class Bad	3rd. Class Indifferent	Total
Perennial	42	45	38	125
Biennial	13	6	1	20
Annual	27	17	11	55
Total	82	68	50	200

USES OF WEEDS DESCRIBED.

In these lists the numbers refer to the number of the weed in the foregoing list, not to the page.

Household Uses.

Domestic Medicines.

Veterinary Medicines.

INDEX.

The figures refer to the *number of the weed*, not to the page.

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Bulletin No. 24

WEST VIRGINIA

Agricultural Experiment Station

MORGANTOWN, W VA.

FLORA OF WEST VIRGINIA.

JUNE, 1892

CHARLESTON, WEST VA.
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1892.

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PRELIMINARY CATALOGUE

—OF

THE FLORA OF WEST VIRGINIA,

C. F. MILLSPAUGH, M. D.

1892.

ABBREVIATIONS.

M. & G.—Profs. H. N. Mertz, and G. Guttenberg.

L. W. N.—Mr. L. W. Nuttall.

V. M.—Miss Verona Mapel.

James.—Prof. Joseph F. James.

Barnes.—Prof. Charles R. Barnes.

Porter.—Prof. Thos. C. Porter.

G.—Dr. H. McS. Gamble.

W.—Dr. Rosecrans Workman.

INTRODUCTORY.

In issuing this Preliminary Catalogue, I do so with no desire to convey an impression that my work in this respect is in any way complete; but simply to enter a wedge, to inspire the few who are working in the field to greater energy.

Few species are recorded in the Liverworts, and Lichens; and in the lower forms of Pond Life, and Fungi, as very little collecting or study has so far been done in these classes.

In this preliminary list I shall not enter into the details of our geology and topography, suffice it to say the State promises more of interest to the botanist than probably any other east of the Mississippi river, as it appears to be the southern limit of many boreal, the northern of many austral, and the eastern limit of many occidental forms. It bids fair also to continue to present many novelties; this may especially be said of all that unexplored and fascinating region laying south of the Great Kanawha River, a region that as far as I can learn the foot of a Naturalist has never trod.

With the exception of a few transient Botanists who have worked over, for their own personal pleasure, the neighborhood of some vacation resort the only attempts at obtaining a knowledge of the vegeteble resources of the State may be summarized as follows:

1867 and 1871, Dr. A. S. Todd as Chairman of a Committee of the Medical Society of West Virginia, published a list of the "Medicinal Plants of West Virginia." This list contains an enumeration of 9 trees, 7 shrubs, and 60 herbs.

1870. Mr. DissDebarr, State Commissioner of Immigration in his "Handbook of West Virginia," compiled a list of the timber trees of the State, in which he enumerated 52 species and added 12 species of shrubs.

1876. Prof. Fontaine in compiling his portion of the Centennial volume upon the "Resources of West Virginia," listed more carefully the forest trees, shrubs and medicinal plants of the State, drawing the last from the publication of Dr. Todd. This work contains an enumeration of 69 trees and 16 shrubs.

1878. Profs. H. N. Mertz and G. Guttenberg published a

check list of the "Flora of West Virginia," being an account of work done along the upper Ohio bottoms, and in the mountains of the north-eastern portion of the State, the latter while located at Harper's Ferry. This list enumerate 59 trees, 37 shrubs and 494 herbs.

Miss Verona Mapel, Preceptress of the High School at Glenville, Gilmer county, has quite thoroughly worked over her immediate vicinity in connection with her school duties. She reports 42 trees, 23 shrubs and 290 herbs. Her list does not include the commoner weeds and herbs, nor the grasses or sedges.

1890–92. Mr. L. W. Nuttall an enthusiastic student of structural botany and a keen observer of forms, has spent considerable time working up his locality, (Nuttallburgh, Fayette county). He has kindly furnished me with a manuscript list of about 700 species, many of which I have had the pleasure of examining while visiting at his hospitable home.

Dr. H. McS. Gamble has done considerable herbalizing in connection with his zoological work in Hardy county, near Moorefield. He has kindly donated to the Station his herbarium consisting of 157 species, which are mentioned among the others of this list.

In compiling this Catalogue I have had the assistance afforded by these lists, as well as personal notes from Prof. Guttenberg, Miss Mapel, Mr. Nuttall and Dr. Gamble. I have also been kindly tendered notes taken in the State by Prof. Joseph F. James, Prof. Chas. R. Barnes, Prof. Thos. C. Porter, and Mr. Aug. D. Selby. Prof. Brown, of the University, has also loaned me his herbarium of Glenville plants for examination, as has also Dr. Workman, of Bayard.

All these contributions are acknowledged in the text by a or name initial appened to species or localities. All localities mentioned, where such credit is not given, record my personal observations.

I am under special obligations to Prof. N. L. Britton for his kind help in comparing numbers of my plants with those in the Columbia College Herbarium, as well as for suggestions and assistance in many ways. I am also idebted to Prof. W. A. Kellerman for the examination of nearly all of the epiphytic fungi in this work; and to Prof. Charles H. Peck for the identification of some of the epiphytes, and all of fleshy fungi.

As to nomenclature: I have followed the principle of priority and the double credit system, as far as my access to literature would allow. Omissions in this matter will be found to be in direct proportion to my lack of ability to refer.

My idea of the matter is as follows: Linnæus had not completed his work of generation until the issue of his "Species Plantarum" in 1753. Any changes that he made, therefore, in his previous work, or while classifying the work of others who preceded him, should be acknowledged as positive. Surely a man has a right to correct his own errors. We should not ignore

nore his later ideas by picking out these errors and attempting to establish them as facts today, simply because the errors had the precedence of the correction of them. Linnæus' "Systema Plantarum" (1735) was little more than a mere list of names and should not be accepted as authority in the face of later work done by himself or some other careful systematist, even if he did not change these names in his "Species Plantarum."

To illustrate this, I feel that Robert Brown's Nasturtium should hold; and that Linnæus' Lepidium (1737) can-not be returned to his Nasturtium (1735). Linnæus named one of our genera Pavia in 1735; he corrected this to Esculus in 1737; but in 1753 decided that Æsculus was the proper name for the genus: Is it not right that we should regard this change and acknowledge his correction by using the name Æsculus hereafter? Properly, following this idea, we have no need to fear that the 15,000 species of Astragalus will be changed to Glycia with an "OK" placed after them; how unfortunate it would be to mark with that American symbol for "all correct" many of the changes that Herr Kuntze advises!

As to the double credit system: I judge it no more than right to give the discoverer of any species credit for his work, even if he does err by placing the species in a wrong genus. It is also proper, I think, to acknowledge the student who afterwards detects the error; especially as this acknowledgement is part of the necessary data in considering the species.

Morgantown, W. Va., July, 1892.

RANUNCULACEÆ.

CLEMATIS, L.

C. Virginiana, L. Virgin's Bower. M. & G.
River banks, fence rows, etc., Monongalia: Marion: Preston: Wood. Webster: Long Glade. Gilmer: Glenville —V. M. Greenbrier: near White Sulphur Springs. Summers: near Hinton. Kanawha: near Charleston. Fayette: near Nuttallburg— L. W. N.

C. viorna, L. Leather Flower.
Thickets in rich soil. Monongalia: Little Falls. Marion: Valley Falls—K. D. Walker. Fayette: near Nuttallburg—L. W. N. Summers: near Hinton.

C. verticillaris, DC. Mountain Clematis.
Rocky Woods. Monongalia: near Cheat View.

ANEMONE, L.

A cylindrica, Gray. Long-fruited Anemone.
Dry Woodlands. Wood: near Leachtown. Jackson: near Sandyville. Rare.

A. Virginiana, L. Thimble-weed. M. & G.
Open woods and meadows. Upshur: near Buckhannon. Monongalia: along the Monongahela River. Randolph: Rich Mountains, alt. 1,825 ft.. Fayette: near Nuttallburg, where it grows as tall as 4 ft.—L. W. N. Frequent throughout the State.

A. Canadensis, L. Pennsylvania Anemone. *A. Pennsylvanica*, L.
Rich woods, rare. Calhoun: along Laurel Run. Gilmer: near Glenville—V. M.

A. quinquefolia, L. Wind-flower. Wood Anemone. *A. nemorosa*, L.
Margins of rich woods and opens. Calhoun: along Laurel Run. Gilmer: near Glenville—V. M. Fayette:

near Nuttallburg—L. W. N. And general throughout the State.

A. trifolia, L.

Rich woods. Mercer: near Ingleside. McDowell: near Elkhorn. Monongalia: near Camp Eden.

The altitude of the first two stations in the southern part of the State is from 2,200-2,350 ft.; these localities are along the same range of mountains as the original station of Canby in Virginia. The Monongalia station in the extreme northern part of the State has an altitude of about 850 ft. and is near Knipes' Pennsylvanian station. Though I have not as yet found the species at any point through the state that would connect these distant points, yet I fully believe that many will be found in the future.

HEPATICA, L.

H. Hepatica (L.), Britt. Hepatica. Liver-leaf. M. & G.

Rocky or rich woods. Gilmer: near Glenville—V. M. Greenbrier: near White Sulphur Springs. Hardy: near Moorefield—G. Mercer: near Bluefield. Monongalia: along Decker's Creek. Fayette: near Nuttallburg, where it often grows in clefts in rocks—L. W. N. And frequent throughout the northern portions of the State.

H. acuta (Pursh). Britt. M. & G.

Rich woods. Gilmer: near Glenville—V. M.—Prof. Brown. Greenbrier: near White Sulphur Springs. Monongalia: near Cheat View. Throughout the State, especially eastward in the mountains. More frequent than the preceding. McDowell: near Elkhorn. Mercer: Bluestone Jc.

SYNDESMON, Hoffm'g.

S. thalictroides (L.), Britt. Rue Anemone. (*Thalictrum anemonoides*, Michx.) M. & G.

Woods and hillsides. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg—L. W. N. Monongalia: near Uffington and Morgantown. Frequent throughout the State. Hardy: near Moorefield—G. Mercer: near Beaver Spr.

Forma **rosea**.

A beautiful rose colored clump of the species has persisted for two years in Monongalia at Little Falls near the Cascade.

THALICTRUM, L.

T. dioicum, L. M. & G., V. M., L. W. N.

Rocky woods: frequent throughout the State. Especially noticeable in the Alleghanies.

T. polygamum, Muhl. Common Meadow Rue. M. & G.

Damp meadows and near streams and ditches. Randolph: rich growths in the bottoms along Tygart's Valley River. Fayette: near Kanawha Falls—James; near Nuttallburg, alt. 2,000 ft.—L. W. N. Gilmer: near Glenville. Frequent throughout the State.

T. purpurascens, L. Purplish Meadow Rue.

Dry, open woods and rocky hillsides. Wirt: near Elizabeth; near Burning Springs. Webster: near Upper Glade. Randolph: along Tygart's Valley River, alt. 2,100 ft. Fayette: near Nuttallburg—L. W. N.

T. clavatum, DC.

Fayette: Near Nuttallburg, in sandy clefts of rocks around waterfall, alt. 200 ft., one station—L. W. N.

TRAUVETTERIA, F. & M.

T. palmata, F. & M. False Bug-bane.

Plentiful along the Blackwater Fork of Cheat, about one mile below Davis in Tucker county. Fayette: near Hawk's Nest; and Loup Creek—James; near Nuttallburg, common—L. W. N.

RANUNCULUS, L.

R. ambigens, Wats. Water Plantain Spear Wort (R. *alismaefolius*, Gray.)

One station only; Upshur: in a marshy spot near Lorentz.

R. abortivus, L. Small-flowered Crowfoot. L. W. N., V. M., M. & G.

Damp, shady places, frequent throughout the State.

R. sceleratus, L. Cursed Crowfoot. V. M.

Moist places, common throughout the State.

R. recurvatus, Poir. Hooked Crowfoot. M. & G.

Rich, open woods. Abundant along the Monongahela river in Upshur, Barbour, Taylor, Marion, and Monongalia counties. Fayette: near Nuttallburg, not common—L. W. N. Mercer: near Simmons.

R. fascicularis, Muhl. Early Crowfoot.
Dry or moist grassy hillsides. Monongalia: near Morgantown. Mineral: near Keyser—W. Gilmer: near Glenville—V. M. Hardy: near Moorefield—G.

R. septentrionalis, Poir. Buttercup.
Moist, shady places. Fayette: near Nuttallburg—L. W. N., and general throughout the State.

R. Pennsylvanicus, L. Pennsylvania Buttercup.
Damp woods. Monongalia and Marion, along the Monongahela river.

R. REPENS, L. Creeping Crowfoot. M. & G.
Low grounds. Mineral: Banks of the Potomac near Keyser. Jefferson: near Shenandale Springs.

R. ACRIS, L. Tall Buttercups.
Waste places infrequent. Wood: near Parkersburg, Jefferson: near Shenandoah Junction. Randolph: in clearings on Cheat Mountain, near Cheat Bridge, alt. 3350 ft. Gilmer: near Glenville—V. M.

HELLEBORUS, L.

H. VIRIDIS, L. Green Hellebore.
Hardy: near Moorefield—G. It was from specimens sent to Dr. Gray from this station by Dr. Gamble, that the location "W. Va." was credited in the Manual.

CALTHA, L.

C. palustris, L. Marsh Marigold.
Two stations only known to me; Grant: in a spring run in deep woods near Bayard, about fifty plants within an area of one hundred feet. Preston: near Terra Alta.

ISOPYRUM, L.

I. trifolium, (L.), Britt. Gold Thread. *Coptis trifolia*, Salisb.
Deep, rich mountain woods. Preston: near Mill Run and Cranesville.

AQUILEGIA, L.

A. Canadensis, L. Wild Columbine. M. & G.
Damp, rocky places. Mineral: along Knobby mountains. Monongalia: along Cheat River. Calhoun: along Little Kanawha River, Gilmer: near Glenville—V. M.;

Prof. Brown. Fayette: near Nuttallburg—L. W. N. Hampshire: near Does Gully. Hardy: near Moorefield.

A small form 6 to 8 inches high, with small leaves and flowers. Mercer: near Beaver Spr.

DELPHINIUM, L.

D. tricorne, Michx. Dwarf Larkspur.

Dry woods. Monongalia: along Cheat and Monongahela Rivers. Marion: along the Monongahela. Gilmer: near Glenville—V. M.; Prof. Brown. Frequent throughout the northern part of the State.

Forma **albiflora.**

Monongalia: prevalent near Stumptown. The flowers are pure white with no tinge of blue.

D. Consolida, L. Field Larkspur.

Frequent in old fields and along roadsides. Lewis: along Stone Coal Creek. Monongalia: near Morgantown. Upshur: near Buckhannon. Randolph: near Beverly. Kanawha: near Kanawha Falls—James.

ACONITUM, Tourn.

A. uncinatum, L. Wild Monk's Hood.

Deep, rich woods along streams. Randolph: along Cheat River near Cheat Bridge. Monongalia: near Camp Eden. Fayette: near Nuttallburg, along New River—L. W. N.

CIMICIFUGA, L.

C. Americana, Michx. American Bug-bane.

Plentiful throughout the mountain regions of Mineral, Hampshire, Grant, Tucker, Hardy: near Moorefield; Randolph, Pendleton, Webster, Pocahontas, and Greenbrier counties. Fayette: near Nuttallburg—L. W. N. McDowell: near Elkhorn.

C. racemosa (L.), Nutt. Rattle-weed, Black Cohosh. M. & G.

Rich opens and clearings. Wood: near Leachtown. Lewis: along Stone Coal Creek. Randolph: near Valley Bend; Point Mountain, alt. 3300 ft. Webster: Buffalo Bull Mountains. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg—L. W. N. and frequent throughout the State.

ACTÆA, L.

A. spicata, (L.) var. **rubra,** Ait. Red Baneberry.

Rich woods, infrequent. Randolph: on Point Mountain. Grant: near Bayard. Tucker: near Davis.

A. alba, Mill. White Baneberry. M. & G.
Rich woods. Randolph: on Point Mountain. Tucker: near Davis. Grant: near Bayard. Fayette: near Nuttallburg.—L. W. N.

HYDRASTIS, L.

H. Canadensis, L. Yellow Root, Yellow Puccoon, Golden Seal.
Deep Rich woods. Jackson: near Ripley. Wirt near Burning Springs. Grant: near Bayard. Upshur: summit on Staunton pike. Lewis: along Leading Creek. Calhoun: along Laurel Run: Gilmer: near Glenville.—V. M.; Prof. Brown. Monongalia: along Cheat River.

XANTHORRHIZA, Marshall.

Z. apiifolia. L.'Her. Shrub Yellow Root.
Rich rocky mountain woods. Nicholas: on Mumble-the-Peg Creek, plentiful. Fayette: near Nuttallburg, common.—L. W. N.

MAGNOLIACEÆ.

MAGNOLIA, L.

M. acuminata, L. Cucumber Tree, "Yellow Linn." M. & G.
Rich woods. Monongalia: along the Monongahela river, especially near Little Falls, Opekiska, and Montana. Wirt: along Little Kanawha River. Randolph: on Point Mountain, alt. 2335–3700 ft. Webster: along Buffalo Bull Mountains. Nicholas: at Beaver Mills, and Collett's Glade. Jackson: near Sandyville. Mineral: near Keyser. Preston: along B. & O. R. R. Randolph: on Cheat Mountain, alt. 2800 ft. Gilmer: near Glenville—V. M. Monroe: near Alderson. Summers: near Greenbrier Stock Yards; near Hinton. Kanawha: near Handley. Harrison: near Shinnston and Lumberport. Fayette: near Nuttallburg—L. W. N.

M. tripetala, L. Umbrella tree. *M. Umbrella*, Lam.
Rich woods near streams. Wirt: near Burning Springs. Randolph: on Point Mountain, alt. 2800 ft. Kanawha: near Charleston—C. R. Barnes; James. Nicholas: near Beaver Mills, alt. 2125 ft. Gilmer: near Glenville—V. M. Monongalia: Little Falls. Summers: near Hinton. Harrison: near Shinnston and Lumberport. Fayette: near Nuttallburg, rare—L. W. N. Hardy: near Moorefield. McDowell: near Elkhorn. Mercer: Bluestone Junction and Ingleside.

M. Fraseri, Walt. Ear-leaved Magnolia.

Deep rich mountain woods. Randolph: on Point Mountain, alt. 3700 ft. Webster: on Buffalo Bull Mountain, alt. 3400 ft. Nicholas: near Beaver Mills, alt. 2125 ft. Fayette: near Nuttallburg – L. W. N. Summers: near Hinton. McDowell: near Elkhorn. Mercer: Bluestone Jc.

LIRIODENDRON, L.

L. Tulipifera L. Tulip Tree, "White, Yellow, or Hickory Poplar." M. & G.

Common in rich woods throughout the State. Magnificent trees in Randolph, Pocahontas, Greenbrier, Webster, Nicholas, and Preston counties. Summers: near Hinton. Fayette: near Kanawha Falls; near Nuttallburg, common—L. W. N. Hardy: near Moorefield—G. Mercer: near Ingleside.

ANONACEÆ.

ASIMINA, Adans.

A. triloba (L.), Dunal. Papaw. M. & G.

Rich soil near streams, common. Wood: near Kanawha Station. Wirt: along Straight Creek. Webster: Buffalo Bull Mountains, alt. 2100 ft. Nicholas: along Peter Creek. Fayette: along Gauley river. Kanawha, Putnam and Mason: along the Great Kanawha. Gilmer: near Glenville – V. M. Greenbrier: near Ronceverte. Summers: near Hinton. Marion: near Worthington, Fairmont and Montana. Monongalia: general. Fayette: near Nuttallburg, common.—L. W. N. Morgan: near Cacapon. Hardy: near Moorefield. Mercer: near Ingleside.

MENISPERMACEÆ.

MENISPERMUM, L.

M. Canadensis, L. Moonseed. V. M., M. & G.

Thickets. Wirt: along Little Kanawha River. Marion and Monongalia: along the Monongahela. Greenbrier: near White Sulphur Springs. Fayette: near Nuttallburg, pistillate plants, rare.—L. W. N.; and frequent along streams throughout the State. Hardy: near Moorefield. Mercer: near Princeton.

BERBERIDACEÆ.

BERBERIS, L.

B. Canadensis, Pursh. Barberry.

Fields and roadsides. Mercer: near Beaver Spring, where it partakes of the nature of a weed.

B. VULGARIS, L.

Thickets and roadsides. Monongalia: a wide escape near Laurel Point. Mercer: a wide escape near Ingleside.

CAULOPHYLLUM, Michx.

C. thalictroides, (L.), Michx. Blue Cohosh. M. & G.

Deep, rich woods. Randolph: Rich Mountains; Point Mountain, alt. 3,300 ft. Monongalia: along the Monongahela River. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg—L. W. N. Mercer: near Bluefield. Frequent throughout the State.

JEFFERSONIA, Barton.

J. diphylla, (L.), Pers. Twin-leaf. M. & G.

Rich woods. Monongalia: near Morgantown. Marion: near Glover's Gap. Wetzell: near Littleton. Marshall: near Glen Easton. Gilmer: near Glenville—V. M.; Prof. Brown. Cabell: near Huntington—Aug. Selby.

PODOPHYLLUM, L.

P. peltatum, L. May Apple. Mandrake. V. M.; M. & G.

Frequent throughout the State, in some rich spots very abundant. Randolph: Rich Mountains, alt. 1610–2125 ft.; Point Mountain, alt. 3300 ft. Fayette: near Nuttallburg—L. W. N. Hardy: near Moorefield—G. Mercer: Bluestone Jc.

NYMPHACEÆ.

CASTALIA, Salisb.

C. odorata, (Dryand). Woodv. & Wood. White Water Lily.

Nymphæa odorata, Ait.

In slack waters. Preston: near Pennsylvania line, rare.

NYMPHÆA, L.

N. advena, Soland. Yellow Pond Lily. V. M.; M. & G.
In slack waters. Preston: near Terra Alta. Wood: Wirt: Calhoun and Gilmer: along the Little Kanawha River. Upshur: near Lorentz. Morgan: along the Little Cacapon. Putnam; near Buffalo. Hardy: near Moorefield.

PAPAVERACEÆ.

SANGUINARIA, L.

S. Canadensis, L. Blood-root. "Coon-root." M. & G.
Rich woods, frequent. Randolph: Point Mountain. Monongalia: near Morgantown. Jefferson: near Flowing Spring, and Shenandale Spring. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg—L. W. N. Throughout the State. Hardy: near Moorefield—G.

STYLOPHORUM, Nutt.

S. DYPHLLUM (Michx.) Nutt. Celandine Poppy.
Old fields. Ohio: near Wheeling—M. & G.

CHILIDONIUM, L.

C. MAJUS, L. Celandine. M. & G.
Waste grounds, near dwellings. Monongalia: near Easton; near Morgantown. Jefferson: near Charlestown, abundant. Lewis: near Weston. Hardy: near Moorefield.—G. Hampshire: near Romney.

PAPAVER, L.

P. DUBIUM, L. Smooth-fruited Corn-popy.
Cultivated grounds, and waste fields. Jefferson: near Shenandoah Jc.; near Charlestown, abundant. Berkeley: near Hedgesville, a weed.

FUMARIACEÆ.

ADLUMIA, Raf.

A. fungosa, Ait. Greene.
Monongalia: climbing over rocks, Tibb's Run.

BICUCULLA, Adans.

B. Cucullaria, (L.) Dutchman's Breeches. M. & G.
Rich woods. Monongalia: near Morgantown; along Cheat River. Gilmer: near Glenville—V. M. Hardy: near Moorefield—G. Fayette: near Nuttallburg—L. W. N.

B. Canadensis, (Goldie.) Squirrel Corn. M. & G.
Rich woods. Monongalia and Marion: along the Monongahela River. Preston: along Cheat River. Fayette: near Nuttallburg—L. W. N.

B. eximina, (DC.)
Pocahontas: summit of Spruce Knob, alt. 4800 ft.—A. D. Hopkins.

NECKERIA, Scop.

N. glauca, (L.) Pale Corydalis, M. & G.
On rocks. Randolph: on Lone Sugar Knob. Gilmer: near Glenville—V. M.

N. flavula, (Raf.) Yellow Corydalis.
Rich soils. Common throughout the northern counties. Fayette: near Nuttallburg—L. W. N. Hardy: near Moorefield.

N. aurea, (Willd.) Golden Corydalis.
Along streams. Hardy: near Moorefield—G.

FUMARIA, L.

F. OFFICINALIS, L. Fumitory.
Waste places. Hardy: near Moorefield—G.

CRUCIFERÆ.

NASTURTIUM, R. Br.

N. OFFICINALE, R. Br. Water Cress. M. & G.
Cold spring runs, frequent. Jefferson: near Shenandale Springs; near Flowing Spring. Lewis: on Leading Creek. Wirt: near Elizabeth.

N. SYLVESTRE, (L.), R. Br. Yellow Wood-cress.
Moist places in open woods, frequent. Monongalia: near Morgantown. Preston: Cold Spring. Marion: near Montana. Jefferson: near Shenandale Springs.

N. obtusum, Nutt.
River banks. Mason: near Point Pleasant.

N. palustre, (L.), DC. Marsh Cress. M. & G.
Marshy places and glades, infrequent. Webster: near Welch Glade. Kanawha: near Charleston. Preston: near Kingwood. Fayette: near Nuttallburg, rare—L. W. N. Mason: near Point Pleasant; Banks of the Ohio. Wood: near Parkersburg.

N. hispidum, (Desv.), DC. *N. palustre* var. *hispidum*, Gray.
Preston: near Kingwood.

N. ARMORACIA, (L.), Fries. Horseradish. M. & G.
Escaped from cultivation in many waste places and fields. Marshall: frequent in several places where it is complained of as a weed; difficult to eradicate. Jefferson: near Shenandoah Junction.

BARBAREA, R. Br.

B. VULGARIS, R. Br. Yellow Rocket. M. & G.
Becoming a weed in many places in Jefferson: Berkeley: Morgan: Hardy: near Moorefield—G; and other counties.

B. PRÆCOX, (Smith), R. Br, Scurvy Grass.
Running wild near Charlestown in Jefferson; and Lewis: near Weston.

ARABIS, L.

A. patens, Sulliv.
Moist rocky places in woods. Monongalia: near Monongahela River at Uffington. Preston: Cold Spring.

A. lævigata, (Muhl.), Poir. M. & G.
Rocky places, frequent. Monongalia: near Morgantown, and Little Falls. Marion: near Catawba. Fayette: near Nuttallburg, common—L. W. N.

A. Canadensis, L. Sickle-pod. M. & G.
Woods, and along cool runs. Monongalia: near Granville, near Morgantown and Uffington.

A. lyrata, L. M. & G.
Rocky or sandy places. Monongalia: shores near mouth of Cheat River. Mercer: near Ingleside.

CARDAMINE, L.

C diphylla, (Michx.), Wood. Pepper Root. *Dentaria diphylla*, Michx. M. & G.
Common in deep, cool ravines and in the mountains. Monongalia: Wirt: Wood: Calhoun: Lewis: Upshur: Jef-

ferson: Grant: and Tucker counties. Gilmer: near Glenville—V. M.; Prof. Brown. Fayette: Hawk's Nest—Porter; near Nuttallburg—L. W. N.

C. heterophylla, (Nutt.), Wood. *D. heterophylla*, Nutt.
Rocky, moist places. Monongalia, near Little Falls; opposite Uffington. Fayette: near Nuttallburg—L. W. N.

C. laciniata, (Muhl.), Wood. M. & G.
Moist woods, frequent. Monongalia: opposite Beechwoods and Uffington; near Little Falls. Preston; Cold Spring and elsewhere. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg—L. W. N. Hardy: near Moorefield—G.

Var. **multifida.** (Muhl.)
Rich woods. Monongalia: near Little Falls.

C. hirsuta, L. Small Bitter Cress. M. & G.
Wet places. Monongalia: Monongahela River below Morgantown; above Little Falls. Marion: near Catawba and elsewhere. Fayette: near Nuttallburg—L. W. N.

C. bulbosa, (Schreb), B. S. P. Spring Cress. *C. rhomboidea*, DC. M. & G.
Wet meadows and springy places. Preston: Cold Spring. Monongalia: road to Cheat River beyond Easton. Wood: Kanawha Station. Fayette: near Nuttallburg, common—L. W. N. Mercer: near Bluefield.

C. Douglassii, (Torr.), Britt. (*C. rhomboidea*, var. *purpurea*, Torr.)
Damp places. Monongalia: near Morgantown.

C. rotundifolia, Michx. Mountain Water Cress. M. & G.
Cool Springs. Preston: Cold Spring. Jefferson: Flowing Spring. Wirt: near Burning Springs. Calhoun: Laurel Run. Monongalia; near Morgantown.

DRABA, L.

D. ramosissima, Desv. Whitlow Grass.
On wet cliffs. Jefferson: cliffs along Shenandoah River between Millville and Harper's Ferry. Tucker: Cliffs near Falls of Blackwater. Hardy: near Moorefield.

D. verna, L. Shad Flower.
Sandy wastes and roadsides. Monongalia: banks of Falling Run; banks Monongahela below Morgantown, and near Little Falls. Marion: near Opekiska. Fayette: near Nuttallburg—L. W. N.

HESPERIS, L.

H. matronalis, L. Dame's violet.
Escaped to waste places. Monongalia: cinders of railroad banks near Morgantown.

SISYMBRIUM, L.

S. officinale, (L.), Scop. Hedge Mustard. M. & G.
Roadsides and ditches, too common throughout the State.

S. Thalina, (L.), Gay.
Waste grounds. Fayette: near Nuttallburg—L. W. N.

ERYSIMUM, L.

E. cheiranthoides, L. Worm-seed Mustard. M. & G.
Roadsides and railroad embankments. Monongalia: near Morgantown. Jefferson: near Shenandoah Junction. Mineral: near Piedmont.

CAMELINA, Crantz.

C. sativa, (L.), Crantz. False Flax.
Fields and waste grounds. Mineral: near Keyser—W. Jefferson: near Charlestown; near Shenandoah Jc.

BRASSICA, L.

B. nigra, (L.), Koch. Black Mustard. M. & G.
Fields and waste places. Fayette: near Nuttallburg, much eaten as "greens" in spring—L. W. N. A common weed throughout the State.

B. sinapistrum, Boiss. Charlock. "Crowd-weed." Kraut-weed.
A miserable weed in wheat fields in Jefferson and Berkeley counties. Less abundant elsewhere throughout the State.

CAPSELLA, Moench.

C. Bursa-pastoris, (L.), Moench. Shepherd's Purse. L. W. N., M. & G.
Fields and roadsides, common throughout the State.

LEPIDIUM, L.

L. Virginicum, L. Wild Peppergrass. L. W. N., M. & G.
Fields and roadsides, common throughout the State.

L. **CAMPESTRE** (L.), R. Br. English Peppergrass, "Glenn-weed," "Glenn-pepper," "Crowd-weed."

An exceedingly abundant weed in Jefferson and Berkeley counties, where it is known as "Glenn-weed," it being first noticed in the fields of Colonel Glenn; who tells me that the weed was quite plentiful, however, in these fields before he purchased them, having been brought there in clover seed bought in Hagarstown, Md., and sown by the previous owner of the farm. The weed is now the worst pest in the large wheat fields of those counties.

RAPHANUS, L.

R. **SATIVUS**, L. Radish.

Frequently persistent in waste grounds and cultivated fields, in many parts of the State.

CAPPARIDEÆ.

CLEOME, L.

C. **SPINOSA**, L. Spider Flower. C. *pungens* Willd.

Escaped from farther south, at Barboursville near the Guyandootte River, Cabell county—Prof. James, 1877.

CISTINEÆ.

HELIANTHEMUM, Pers.

H. **majus**, (L.) B. S. P. Frost-weed. *H. Canadense*, Michx.

Dry soils. Preston: near Terra Alta.

LECHEA, L.

L. **minor**, L. Pin-weed. *L. major*, Michx.

Dry places. Summers: near Hinton. Fayette: near Nuttallburg, alt. 1600 ft.—L. W. N.

L. **Leggettii**, Britt & Hollick. *L. minor*, Lam.

Dry sandy places. Fayette: near Nuttallburg, plentiful at an alt. of 2000 ft.—L. W. N.

VIOLARIEÆ.

VIOLA, L.

V. **pedata**, L. Bird's-foot Violet.

Sandy soils. Monongalia: at The Flats. Mineral: along the Potomac near Keyser—W. Randolph: on Point Mountain.

Var. **bicolor**, Pursh. Pansy Violet.

Hardy: near Moorefield—G. Hampshire: near Romney—A. D. Hopkins.

V. palmata, L. M. & G.

Near runs in moist ground. Monongalia: near The Flats, Morgantown. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg—L. W. N.

V. cucullata, Ait. Common Blue Violet. L. W. N., V. M., M. & G., G.

Low grounds; common throughout the State.

V. sagittata, Ait. Arrow Leaved Violet. M. & G.

Dry or moist, sandy places. Monongalia: near Morgantown, Uffington and Little Falls. Preston: near Cold Spring. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg—L. W. N.

V. blanda, Willd. Sweet White Violet. M. & G.

Damp woods. Monongalia; near Morgantown. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg—L. W. N., and frequent throughout the State. McDowell: near Elkhorn.

V. primulaefolia, L.

Damp soils. Fayette: near Nuttallburg—L. W. N. McDowell: near Elkhorn.

V. lanceolata, L. Lance-leaved Violet.

Boggy places. Monongalia: up Falling Run, above Morgantown, the only station so far known to me.

V. rotundifolia, Michx. Round-leaved Violet. M. & G.

Cold woods. Randolph: Rich Mountains, alt. 2110 ft. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg—L. W. N. Mercer: near Ingleside and Wills.

V. pubescens, Ait. Yellow Violet. M. & G.

Rich woods. Mineral: near Keyser—W. Randolph: Rich Mountains, alt. 2125 ft. Grant: near Bayard. Tucker: along Blackwater Fork of Cheat. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg—L. W. N. Monongalia: near Cassville.

Var. **scabriuscula**, T. & G.

Rich woods. Monongalia: near Morgantown, common. Fayette: near Muttallburg—L. W. N.

V. hastata, Michx.
Woodlands. Fayette: near Nuttallburg—L. W. N. Oak woods. Mercer: near Bluefield. McDowell: near Elkhorn.

V. Canadensis, L. Canada Violet. M. & G.
Rich woods. Monongalia: magnificent specimens in great profusion along the woods bordering the F. M. & P. R. R., between Beechwoods and Little Falls; near Uffington. Marion: near Opekiska and Catawba. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg—L. W. N. McDowell: near Elkhorn.

V. striata, Ait. Pale Violet. M. & G.
Along runs. Monongalia: the most common species. Fayette: near Nuttallburg—L. W. N. Hardy: near Moorefield—G. McDowell: near Elkhorn.

V. rostrata, Muhl. Long-spurred Violet.
Hillside. Fayette: near Nuttallburgh—L. W. N.

V. tenella, Muhl. Field Violet. (*V. tricolor, var. arvensis*, DC.)
Fields and rocky opens. Monongalia: common. Mineral: near Keyser—W. Fayette: near Nuttallburg—L. W. N.

SOLEA, Ging.

S. concolor (Forst.), Ging. Green Violet. M. & G.
Rich woods. Wirt: near Burning Springs. Calhoun: along Laurel Run. Gilmer: near Glenville—V. M.

POYLGALEÆ.

POLYGALA, L.

P. sanguinea, L. Red Milkwort.
Sandy fields. Wood: near Kanawha Station. Webster: Upper Glade. Preston near Terra Alta. Fayette: near Nuttallburg, alt. 2400 ft.—L. W. N.

Forma. **albiflora**.
In the glades of Webster and Preston counties.

P. mariana, Mill. *P. fastigiata, Nutt.*
Damp places. Preston: near Terra Alta.

P. Curtissii, Gray.
Glady spots. Fayette: near Nuttallburg—L. W. N.

P. cruciata, L. Cross Milkwort.

Margins of Glades. Preston: near Reedsville. Webster: Upper Glade.

P. verticillata, L. Whorled Milkwort.

Dry places. Wirt: near Burning Springs. Lewis: near Leading Creek. Upshur: near Buckhannon. Summers: near Hinton.

P. ambigua, Nutt.

Dry soils. Wood: near Lockhart's Run. Wirt: near Elizabeth. Calhoun: on Nigh-Cut Hill. Monongalia: hills below Morgantown. Fayette: near Nuttallburgh—L. W. N.

P. Nuttallii, T. & G.

Mountain woods. Fayette: near Nuttallburgh, alt. 2000 ft.—L. W. N.

P. Senega, L. Seneca Snake-root.

Rocky soils and rich bottoms. Mineral: near Keyser—W. Webster: in Welsh, Long and Collett's glades. Preston: Reedsville glade. (Long glade is said to be white with this species when in bloom.)

P. paucifolia, Willd. Fringed Polygala.

Rocky woods. Mineral: near Keyser along the Knobby Mountains.—W. Hardy: near Moorefield—G.

CARYOPHYLLEÆ.

DIANTHUS, L.

D. Armeria, L. Deptford Pink.

Fields, roadsides, and river banks. Marion: near Catawba—K. D. Walker. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg, rare—L. W. N.; near Kanawha Falls—James. Summers: near Hinton. Jefferson: at Harper's Ferry—M. & G.

SAPONARIA, L.

S. officinalis, L. Soap-wort. Bouncing Bet.

Becoming a very common weed along roadsides throughout the more settled portions of the State. In especially large areas along the B. & O. R. R. and Shenandoah Valley R. R., in Jefferson Co. Calhoun: Grantsville. Gilmer: Glenville—V. M. Berkeley: Martinsburg. Summers: near Hinton. Fayette: near Nuttallburg—L. W. N. Hardy: near Moorefield—G. Monongalia: near Lock 9.

SILENE, L.

S. stellata, (L.), Ait. Starry Campion. M. & G.
Wooded banks, frequent. Wood: Wirt: Calhoun: Gilmer: Lewis: and Upshur, common. Preston: near Terra Alta. Summers: near Hinton. Greenbrier: near White Sulphur Springs. Fayette: near Nuttallburg—L. W. N. Hardy: near Moorefield—G.

S. Virginica, L. Fire Pink. Catchfly. M. & G.
Open woods. Kanawha: near Charleston—Barnes. Fayette: near Nuttallburg, very common—L. W. N. Mercer: near Bluefield. Monongalia: permian formations at Cassville.

S. nivea, Otth.
Wooded banks. Fayette: near Nuttallburg—L. W. N.

S. Pennsylvanica, Michx. Wild Pink.
Open woods. Monongalia: near Morgantown. Mineral: near Keyser—W. Gilmer: near Glenville—V. M. Hampshire: Doe's Gully.

S. antirrhina, L. Sleepy Catchfly.
Dry places. Fayette: near Nuttallburg—L. W. N.

LYCHNIS, L.

L GITHAGO, (L.), Lam. Corn Cockle. V. M.; M. & G.
A frequent weed in wheat fields throughout the State. Fayette: near Nuttallburg, in shady places—L. W. N.

CERASTIUM, L.

C. VULGATUM, L. Large Mouse-ear Chickweed.
Waste grounds and fields. Ohio: Cowan's Hill, near Wheeling—M. & G. Gilmer: near Glenville—V. M. Wood: near Waverly and elsewhere, becoming frequent. Fayette: near Nuttallburg—L. W. N.

C. VISCOSUM, L. Mouse-ear Chickweed.
Fields. Ohio: Cowan's Hill, near Wheeling—M. & G. Fayette: near Nuttallburg—L. W. N. Monongalia: near Morgantown.

C. arvense, L. Field Chickweed. M. & G.
Dry places. Frequent throughout the State.

C. nutans, Raf. Star Chickweed. M. & G.
Woods near streamlets; common in Monongalia and Marion counties.

STELLARIA, L.

S. MEDIA, (L.), Smith. Chickweed. V. M., M. & G.
Damp places, common everywhere. Fayette: near Nuttallburg, blooms all winter—L. W. N.

S. pubera, Michx. Great Chickweed. M. & G.
Shady places, common. Monongalia, Marion and Preston counties. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg—L. W. N. Mercer: near Bluefield.

S. longifolia, Muhl. Long-leaved Stitchwort.
Damp soils. Gilmer: near Glenville—V. M.

ARENARIA, L.

A. SERPYLLIFOLIA, L. Thyme-leaved Sandwort. M. & G.
Sandy banks. Kanawha: near Charleston—Barnes. Hardy: near Moorefield—G.

SPERGULA, L.

S. ARVENSIS, L. Field Spurry.
Fields. Preston: near Cranberry Summit—M. & G.; near Terra Alta.

PORTULACEÆ.

PORTULACA, L.

P. OLERACEA, L. Purslane. "Pussley." L. W. N., M. & G.
A weed in cultivated grounds and gardens. Common throughout the State.

CLAYTONIA, L.

C. Virginica, L. Spring Beauty. M. & G.
Common throughout the northern parts of the State, in rich open woods and along spring runs. Gilmer: near Glenville—V. M.; Prof. Brown. Hardy: near Moorefield —G.

C. Caroliniana, Michx.
Frequent with the former species. Marion, Preston, Wood, Wirt, Calhoun, Gilmer, Lewis, Upshur and Randolph counties. Fayette: near Nuttallburg—L. W. N.

HYPERICINEÆ.

ASCYRUM, L.

A. Crux-Andreae, L. St. Andrew's Cross. M. & G.
Dry sandy places. Upshur: summit of Staunton Pike. Randolph: Rich Mountains; along Tygart's Valley River. Fayette: near Gauley Bridge; near Nuttallburg—L. W. N. Cabell: near Barboursville—James.

HYPERICUM, L.

H. prolificum, L. M. & G.
Glade regions. Webster: Upper Glade. Preston: near Reedsville. Gilmer: near Glenville—V. M. Fayette: near Kanawha Falls—James; near Nuttallburg—L. W. N.

H. densiflorum, Pursh. Shrubby St. John's Wort. M. & G.
Glade regions, and moist meadows. Wood: near Lockhart's Run. Webster: in the glades. Preston: Terra Alta, and Reedsville glades. Fayette: near Nuttallburg—L. W. N.

H. virgatum, Lam. var. **actuifolium**, Coulter.
Fayette: near Hawk's Nest—Porter; near Nuttallburg—L. W. N.

H. PERFORATUM, L. St. John's Wort. "St. John." M. & G.
Fields and roadsides. Randolph: along Tygart's Valley River. Monongalia, Marion, Preston; Grant: near Bayard. Fayette: near Nuttallburg—L. W. N. Not yet very plentiful in the State.

H. maculatum, Walt. Spotted St. John's Wort. M. & G.
Glade regions and wet places. Wood: near Kanawha Station. Wirt: near Elizabeth. Preston: near Reedsville and Terra Alta. Webster: Upper, Long, and Welsh Glades. Fayette: near Hawk's Nest and Kanawha Falls—James; near Nuttallburg—L. W. N.

M. mutilum, L. L. W. N., M. & G.
Ditches and low grounds, common throughout the State.

H. Canadense, L. Canadian St. John's Wort.
Glade regions of Preston and Webster counties. Fayette: near Nuttallburg, in spahgnum bogs—L. W. N.

H. gentianoides, (L.), B. S. P. Orange Grass. (*H. Sarthora*, Michx.
Dry fields. Monongalia: near The Flats. Wood:

near Kanawha Station. Fayette: near Kanawha Falls—James.

H. adpressum, Barton.
Moist grounds. Greenbrier: near White Sulphur Springs.

H ellipticum, Hook.
In sphagnous glades. Preston: near Terra Alta.

MALVACEÆ.

ALTHÆA, L.

A. ROSEA, L. Hollyhock.
Appears annually along the B. & O. R. R. tracks in Berkeley: near North Mountain, apparently a thorough establishment.

MALVA, L.

M. ROTUNDIFOLIA, L. Common Mallow. G., L. W. N., M. & G.
Cultivated grounds and waysides, a common weed.

M. MOSCHATA, L. Musk Mallow.
Roadsides and meadows escaped from cultivation. Lewis: along Stone Coal Creek. Upshur: near Lorentz. Monongalia: near Morgantown.

SIDA, L.

S. SPINOSA, L. M. & G.
Waste grounds and fields. Monongalia: near Morgantown, common. Fayette: near Nuttallburg—L. W. N. Jefferson: near Shepherdstown. Mason: near Point Pleasant.

S. Napæa, Cav.
Rocky banks along the Great Kanawha River. Kanawha: opposite Cannelton. Fayette: Quinnimont; near Nuttallburg, frequent and always with 8 carpels—L. W. N. Mason: near Point Pleasant.

ABUTILON, Gaertn.

A. AVICENNÆ, Gaertn. Indian Mallow. American Jute.
A too common weed in waste and cultivated soils. Monongalia, Wood, Wirt, Calhoun; Mason: near Point Pleasant; near Brighton. Fayette: near Nuttallburg—L. W. N. Berkeley: near Martinsburg, a very bad weed.

HIBISCUS, L.

H. Moscheutos, L. Swamp Rose Mallow.
Brackish, marshy places, and ditches near salt works. Mason: near Point Pleasant. Kanawha: near Charleston. Fayette: near Nuttallburg—L. W. N. The pink form, Jackson: near Sandyville. Hardy: near Moorefield.

H. Trionum, L. Bladder Ketmia. M. & G.
Cultivated grounds. Monongalia: a weed in our experimental plats.

TILIACEÆ.

TILIA, L.

T. Americana, L. Linden. Basswood. V. M., M. & G.
Rich woods. Gilmer: at DeKalb P. O. Randolph: on Point Mountain. Grant: near Bayard. Monongalia: near Morgantown, Uffington and Little Falls. Mason: near Point Pleasant. McDowell: near Elkhorn.

T. heterophylla, Vent. White Basswood. "Lin."
Deep woods. Jefferson: near Charlestown, near Flowing Spring Mill. Fayette: near Nuttallburg—L. W. N.

LINEÆ.

LINUM, L.

L. Virginianum, L. Wild Flax.
Open woods, borders and roadsides. Wood, Wirt, Calhoun, Gilmer, Lewis and Upshur. Randolph: along Tygart's Valley River. Webster and Nicholas counties. Kanawha: near Peabody; near Coalburgh—James. Jackson, Monongalia, and Preston. Fayette: near Gauley Bridge; near Kanawha Falls—James; near Nuttallburgh—L. W. N. Kanawha: near Charleston—James.

L. striatum, Walt.
Damp places. Webster: in Upper and Long Glades. Preston: in glades near Terra Alta and Reedsville. Fayette: near Nuttallburg, in sphagnous bog—L. W. N. Monongalia: at Camp Eden.

L usitatissimum, L. Flax.
An uncommon adventive. Fayette: along the C. & O. R. R., near Nuttallburg—L. W. N.

GERIANIACÆ.

GERANIUM, L.

G. maculatum, L. Wild Geranium. L. W. N., V, M., M. & G.
Open woods and clearings, frequent throughout the State. A small form with leaves round in outline and from 1-2 in. in diameter at Bluefield, Mercer county.

G. Robertianum, L. Herb Robert.
Rocks of cool, shaded ravines, rare. Marion: near Fairmont. Gilmer: near Glenville—V. M.

G. Carolinianum, L. Cranesbill.
Fields, meadows and waste places. Mercer: near Ingleside. Fayette: near Nuttallburg—L. W. N. Kanawha: near Charteston—Barnes. Monongalia: on the University Campus; and frequent throughout the State.

FLOERKEA, Willd.

F. proserpinacoides, Willd. False Mermaid.
Wet places. Ohio: near Wheeling—M. & G. Preston: glades near Terra Alta.

OXALIS, L.

O. Acetosella, L. Wood Sorrel.
Deep, rich, mountain woods. Randolph: on Point Mountain; Cheat Mountain near Cheat Bridge, where this species grows in such profusion as to actually carpet the Spruce forests. Grant: near Bayard. Tucker: near Davis; and Land of Canaan. Gilmer: near Glenville—V. M.

O. violacea, L. M. & G.
Rich, cool woods. Randolph: on Point Mountain. Monongalia: up Falling Run; at Uffington and Little Falls. Marion: near Beechwoods; Opekiska and Catawba. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg, rare—L. W. N. Hardy: near Moorefield—G. Mercer: near Beaver Spring.

O **CORNICULATA**, var. **stricta**, (L.) Sav. Sheep Sorrel. L. W. N., V. M., M. & G.
Fields, cultivated grounds and roadsides. Common throughout the State.

O. recurva, Ell.
Open places. Fayette: near Nuttallburg, common—L. W. N.

IMPATIENS, L.

I. aurea, Muhl. Pale Touch-me-not. *I. pallida*, Nutt. M. & G.
Rich soils near streamlets. Gilmer: near Glenville—V. M. Kanawha: near Charleston. Eayette: near Nuttallburg—L. W. N.; and common throughout the State. Also common in the deep, primitive forests along spring runs. Randolph: on Rich and Cheat Mountains. Grant: near Bayard. Tucker: along the Blackwater Fork of Cheat. Hardy: near Moorefield—G.

I. biflora, Walt. Spotted Touch-me-not. *I. fulva* Nutt. L. W. N., M. & G.
Shady, moist places, more common than the preceding species and generally seeking lower altitudes.

RUTACEÆ.

XANTHOXYLUM, L.

X. Americanum, Mill. Prickly Ash. Toothache-tree.
Rocky woods, becoming rare. Jefferson: near Flowing Spring. Monongalia: Decker's Creek. Taylor: along Cheat River.

RUTA, L.

R. GRAVEOLENS, L. Rue.
Escaped from gardens. Randolph: on Point Mountain along the road about half way to the summit.

PTELEA, L.

P. trifoliata, L. Wafer Ash. Hop-tree.
River banks. Jefferson: near Harper's Ferry —M. & G. Hancock: along Oak Run. Brooke: on Short Creek. Summers: near Hinton, on banks of New River, common.

SIMARUBEÆ.

AILANTHUS, Desf.

A. GLANDULOSUS, Desf. Tree of Heaven. M. & G.
Naturalized from China. The seeding-in of this cultivated species is so profuse in the following localities as to render it a great nuisance. Monongalia: near Morgantown. Gilmer: De Kalb P. O. Lewis: near Weston. Kanawha: Pocotaligo. Jackson: near Sandyville. Marion: Fairmont. Gilmer: near Glenville—V. M. Jefferson: near Harper's Ferry, and Charlestown.

ILICINEÆ.

ILEX, L.

I. opaca, Ait. American Holly.

Moist woodlands. Marion: near Nuzums. Randolph: near Rich Mountains and Laurel Hills. Kanawha: near Charleston—Barnes. Fayette: near Hawk's Nest, large trees 8-12 inches in diameter—Porter; Nuttallburg, in most woods common—L. W. N. McDowell: near Elkhorn.

I. monticola, Gray.

Damp woods. Randolph: near sumit of Point Mountain; Rich Mountain, near Lone Sugar Knob; Cheat Mountain, near "The Battle Field." Kanawha: near Charleston—James.

I. mollis, Gray.

Deep woods. Fayette: near Nuttallburg—L. W. N.

I. verticillata, (L.), Gray. Black Alder. Winterberry.

Frequent in swampy places, throughout the central and northern counties. Fayette: near Nuttallburg—L. W. N.

CELASTRINEÆ.

EUONYMUS, L.

E. atropurpureus, Jacq. Burning Bush. M. & G.

Margins of woods and thickets. Jackson: near Sandyville. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg, rare—L. W. N.

E. Americanus, L. Strawberry Bush.

Rocky, wooded river banks. Fayette: along the Great Kanawha River, below Gauley Bridge; near Nuttallburg, common—L. W. N.

CELASTRUS, L.

C. scandens, L. Climbing Bitter-sweet. Wax-work. M. & G.

Thickets, fence rows and along streams, frequent. Wood: near Limestone Ridge. Monongalia and Marion: along the Monongahela River. Fayette: near Nuttallburg—L. W. N.

RHAMNEÆ.

RHAMNUS, L.

R. Caroliniana. Walt.
McDowell: along Tug Fork of the Big Sandy river near Elkhorn; at Welch, along the same stream.

CEANOTHUS, L.

C. Americanus, L. New Jersey Tea. M. & G.
Dry, open woods. Upshur: Summit on Staunton Pike. Jackson: Sandyville. Gilmer: Glenville—V. M. Fayette: near Nuttallburg—L. W. N. Hardy: near Moorefield.

AMPELIDEÆ.

VITIS, L.

V. Labrusca, L. Northern Fox-grape.
Damp, rich thickets. Randolph: near Valley Head. Gilmer: near Glenville—V. M. Summers: near Hinton.

V. aestivalis, Michx. Summer Grape. M. & G.
Thickets. Wirt: along Straight Creek. Randolph: on Point Mountain. Fayette: near Nuttallburg, common—L. W. N. Summers: near Hinton.

V. cordifolia, Michx. Frost Grape. M. & G.
Thickets and banks of streams. Wirt: along Straight Creek. Randolph: Valley Head; Point Mountain Road. Fayette: near Nuttallburg, common—L. W. N. Summers: near Hinton. Kanawha: near Charleston.

V. riparia, Michx.
Banks of streams. Randolph: near Valley Head; Point Mountain Road. Summers: near Hinton. Jefferson: Shenandoah Jc.

V. rupestris, Scheele. Sand Grape. Sugar Grape.
Rocky banks of New river in Fayette near Nuttallburg, plentiful—L. W. N.

V. rotundifolia, Michx. Muscadine. Southern Fox Grape.
Rich river banks. Randolph: near Valley Head. Fayette: near Nuttallburg, rare, on mountain side climbing over trees—L. W. N. Summers: near Hinton.

V. quinquefolia (L.), Lam. Virginia Creeper. American Ivy. (*Ampelopsis quinquefolia*, Michx.) M. & G.
Woods and thickets. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg—L. W. N.; and common throughout the State.

CISSUS, L.

C. Ampelopsis, Pers. (*Vitis indivisa*, Willd.)
River banks. Ohio: near Wheeling—M. & G. Summers: near Hinton.

SAPINDACEÆ.

ÆSCULUS, L.

Ae. glabra, Willd. Ohio or Fetid Buckeye. M. & G.
Low lands near streams. Wirt: along Straight Creek. Gilmer: near Glenville—Prof. Brown. Along the Ohio river, common. Monongalia: near Uffington.

Ae. octandra, Marsh. Sweet Buckeye. *Ae. flava*, Ait.
Rich mountain woods. Webster: Buffalo Bull Mountains, alt. 2,100 ft. Gilmer: near Glenville—V. M. Summers: near Hinton. Kanawha: near Charleston and Handley. Marion: near Worthington.

Var. **purpurascens,** Gray.
Woodlands. Fayette: near Nuttallburg—L. W. N.

Ae. Pavia, L.
Rich lands along streams. McDowell: along Tug Fork near Elkhorn.

ACER, L.

A. Pennsylvanicum, L. Striped Maple. M. & G.
Rich, cool woods. Randolph: on Point Mountain; Staunton Pike on Cheat Mountain. Webster: on Buffalo Bull Mountain. Grant: near Bayard. Tucker: on Blackwater Fork of Cheat. Fayette: near Nuttallburg—L. W. N. and elsewhere in the mountains. McDowell: near Elkhorn.

A. spicatum, Lam. Mountain Maple.
Same localities as previous species, except Fayette, but more plentiful where found. Greenbrier: near White Sulphur Springs. McDowell: near Elkhorn.

A saccharum, Marsh. Sugar Maple. (*A. saccharinum*, Wang., not L.) V. M., L. W. N., M. & G.

Plentiful throughout the State, especially, however, in the central counties. Randolph: Summit Point Mountain, alt. 3,700 ft. Webster: Buffalo Bull Range, alt. 27–3,600 ft.

Var. **nigrum,** (Michx. f.), Britt. Black Sugar Maple. V. M. L. W. N.

With the preceding, almost as plentiful.

A. saccharinum, L. White or Silver Maple. (*A. dasycarpum*, Ehrh.) M. & G.

Banks of Little Kanawha: Gauley River: Great Kanawha, and Ohio. Fayette: near Nuttallburg—L. W. N.; and elsewhere frequent.

A. rubrum, L. Red or Swamp Maple. G., L. W. N., M. & G.

Common throughout the State, where it grows upon the hills and in the mountains, as well as in low places.

NEGUNDO, Moench.

N. aceroides, Moench. Box Elder, Ash-leaved Maple. M. & G.

Common near rivers throughout the northern and middle counties. Lewis: along Leading Creek. Gilmer: near Glenville—V. M. Summers: near Hinton. Berkeley: near Martinsburg. Hardy: near Moorefield—G.

STAPHYLEA, L.

S. trifolia, L. Bladder-nut. M. & G.

Rocky woods, thickets and opens. Wirt: near Elizabeth. Monongalia: near Morgantown and Stumptown. Gilmer: near Glenville. Fayette: near Nuttallburg—L. W. N.

ANACARDIACEÆ.

RHUS, L.

R. typhina, L. Staghorn Sumach. M. & G.

Dry hillsides. Gilmer: DeKalb Postoffice; near Glenville—V. M. Monongalia: near Stewartown. Summers: near Hinton. Fayette: near Nuttallburg—L. W. N.

During the season of 1890 to 1891 hundreds of plants of this species were noted in Monongalia county to have the inflorescence reverted to leaves, making a strikingly beautiful proliferation when young. This effect, according to Dr. Britton, formed the type of the Linnæan species, *Datisca hirta* (L. Sp. Pl. 1037.) collected by Kalm near Philadelphia, Pa.

R. glabra, L. Smooth Sumach. M. & G.

Frequent or very common in all parts of the State, in rocky or barren soils. Randolph: Point Mountain, alt. 2200 ft.; Cheat Mountains, alt. 27—3600 ft. Cabell: near Barboursville—James. Summers: near Hinton. Fayette: near Nuttallburg, not common—L. W. N. Hardy: near Moorefield—G.

R. copallina, L. Dwarf Sumach. M. & G.

Dry fields and rocky places. Wood: near Lockhart's Run, plentiful. Webster: Buffalo Bull Mountains, alt. 2575 ft. Randolph: Cheat Mountains, alt. 3200 ft. Monongalia: near Ice's Ferry. Fayette: near Nuttallburg, alt. 2000 ft., common—L. W. N.; and frequent throughout the State. Mercer: Beaver Springs and Ingleside.

R. venenata, L. Poison Sumach. Poison Elder.

Swampy places. Randolph: Stalnaker Run. Preston: near Terra Alta, infrequent.

R. radicans, L. Poison Vine. Poison Ivy. Including *R. toxicodendron*, L. M. & G.

Thickets and low grounds, very common throughout the State. Monongalia: abundant everywhere in the neighborhood of streams. Webster: Buffalo Bull Mountains, alt. 2100 ft. Kanawha: Pocotaligo. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg—L. W. N. Summers: near Hinton. Mason: near Point Pleasant. Mercer: Princeton, Ingleside and Wills.

R. Canadensis, Marsh. Fragrant Sumach. (*R. aromatica*, Ait.)

Dry or stony soils. Brooke: roadside between Wellsburgh and Bethany College—M. & G. Hardy: near Moorefield—G.

LEGUMINOSÆ.

BAPTISIA, Vent.

B. tinctoria (L.), R. Br. Wild Indigo. "Shoo Fly." M. & G.

Sandy opens. Randolph: along Middle Fork; along Tygart's Valley River; Point and Rich Mountains. Webster: beyond Addison. Nicholas: between long and Collett's Glades. Gilmer: near Glenville—V. M. Kanawha: near Coalburg—James. Fayette: near Nuttallburg—L. W. N. Preston: near Terra Alta.

B. villosa, Ell.

Rocky woods. Mercer: near Ingleside.

B. australis, R. Br. Blue False Indigo.
River shores. Ohio: along the Ohio near Wheeling—M. & G. Along New river. Fayette: near Nuttallburg, common—L. W. N. Summers: near Hinton, abundant. Mercer: Beaver Spr.

LUPINUS, L.

L. perennis, L. Lupine.
Sandy soils. Monongalia: near mouth of Cheat River.

MEDICAGO, L.

M. SATIVA, L. Lucerne.
Dry Places. Monongalia: in cinders of railroad near Morgantown, where it has persisted for several years.

M. LUPULINA, L. Black Medic.
Dry places. Marion: near Catawba-- K. D. Walker. Monongalia: near Uffiington.

MELILOTUS, Juss.

M. OFFICINALIS (L.), Lam. Yellow Melilot.
Ohio: near Wheeling—M. & G.

M. ALBA, L. White Melilot. Sweet Clover. Bokhara Clover.
Roadsides and ditches. Jackson: near Sandyville. Wood: near Parkersburg. Monongalia: near Morgantown. Berkeley: near Martinsburg. Jefferson: near Summit Point, and Shenandoah Junction. Mason: near Pt. Pleasant. Mineral: near Keyser. Hardy: near Moorefield.

TRIFOLIUM, L.

T. ARVENSE, L. Rabbit-foot Clover. M. & G.
Established in many places along roadsides and in old fields. Kanawha: near Pocotaligo. Jackson: along C. & P. Pike. Mineral: near Keyser—W. Cabell: near Barboursville—James. Jefferson: near Charlestown. Hampshire: near Romney.

T. PRATENSE, L. Red Clover. L. W. N., M. & G.
A common escape to fields, roadsides, and open woods; even in the higher Alleghenies.

T. REPENS, L. White Clover. L. W. N., M. & G.
Fields, open woods, and waste places; common throughout the State.

T. hybridum, L. Alsike Clover.

Becoming frequent in fields and meadows. Monongalia: on the University Campus.

T. agrarium, L. Yellow Clover. M. & G.

Sandy hills and roadsides. Upshur: near Buckhannon; summit on Staunton Pike. Randolph: Cheat Mountain Battlefield. Cabell: near Huntington James. Hampshire: near Romney.

T. procumbens, L. Low Yellow Clover. M. & G.

Sandy fields, and roadsides. Kanawha: near Charleston—Barnes. Jackson: plentiful in fields and along roads. Fayette: near Nuttallburg—L. W. N.

TEPHROSIA, Pers.

T. Virginiana, (L.), Pers. Goat's Rue.

Dry sandy soils. Monongalia: near Morgantown. Gilmer: near Glenville—V. M.

ROBINIA, L.

R. Pseud-Acacia, L. Yellow Locust. M. & G., V. M., L. W. N.

Common throughout the State, even in the higher mountains.

Dr. Asa Gray, in his account of a "Botanical Excursion to the mountains of North Carolina," says: "On the rocky banks of the Potomac below Harper's Ferry, we saw for the first time the common Locust tree (*Robinia Pseud-acacia*) decidedly indigenous. It probably extends to the southenn confines of Pennsylvania; and from this point south, it is everywhere abundant, but we did not meet with it east of the Blue Ridge." The Blue Ridge forms our eastern boundary line between Jefferson county and the State of Virginia. Our State is therefore the eastern extension of this species, though it extends farther north into Pennsylvania.

R hispida, L. Bristly or Rose Acacia. M. & G.

Rich soils. Monongalia: near Morgantown; near Cheat River. Preston: in Laurel Hills. Summers: near Hinton.

ASTRAGALUS, Tourn.

A. Carolinianus, L. (*A. Canadensis*, L.) M. & G.

River banks. Monongalia: near Camp Eden. Preston: along Cheat River. Webster: Long Glade. Fayette: near Hawk's Nest—James; near Nuttallburg—L. W. N. Summers: near Hinton.

Specimens found by Mr. Nuttall in his locality resemble so completely Linnaeus' description of A. Carolinianus—which, however, is not sufficiently different from his A. Canadensis published later, to consider these as two species—the former must, therefore, take the precedence and stand for the species.

A. ————

An odd species widely different from any known eastern form, which cannot be named on account of lack of fruit on the specimens collected, and our unaccountable inability to find any on the plants later in the season.

Hardy: near Moorefield—A. D. Hopkins.

STYLOSANTHES, Swartz.

S. biflora (L.), B. S. P. Pencil Flower (*S. elatior*, Sw.) M. & G.

Dry, open woods. Wirt: near Burning Springs. Upshur: summit on Staunton Pike. Summers: near Hinton. Fayette: near Nuttallburg, rocky banks of New River—L. W. N. Monongalia: near Camp Eden.

S. hamata (L.), Britt. (*S. procumbens*, Siv.)

Shores of New River. Summers: near Hinton.
First report of this species north of Tennessee.

DESMODIUM, Desf.

D. nudiflorum, (L.), DC. Tick Tree-foil. M. & G.

Rich woons, common. Wood: near Leachtown. Randolph: on Point Mountain. Webster: Buffalo Bull Mountain. Gilmer: near Glenville—Prof. Brown. Fayette: near Nuttallburg—L. W. N. Summers: near Hinton.

D. grandiflorum, (Walt.), DC. *D. acuminatum*, D. C.

Rich woods. Mononongalia: Marion: Preston: Wetzel: Mineral: Jefferson: Berkeley and Calhoun counties. Fayette: near Kanawha Falls—James; near Nuttallburg—L. W. N. Summers: near Hinton. Kanawha: near Charleston; and frequent throughout the State.

D. rotundifolium, (Michx.), DC. "Hive Vine."

Dry, rocky woods. Monongalia: near Morgantown. Lewis: along Leading Creek. Upshur: near Lawrence. Fayette: near Nuttallburg, alt. 1500 ft.—L. W. N.

D. ochroleuca, M. A. Curtiss. M. & G.

Mineral: along Knobby Mountains. Jefferson: near Millville.

D. canescens (L.), DC.

Open woods and clearings. Wood: near Lockhart's Run. Monongalia: campus, Morgantown. Summers: Riffe; Wolf Creek. An abundant weed. Fayette: near Nuttallburg—L. W. N. Monroe: near Alderson; the worst weed in some fields. Mason: near Point Pleasant.

D. cuspidatum (Muhl.), Hook.

Thickets. Monongalia: along Decker's Creek; near the mouth of Cheat River. Marion: near Little Falls. Wood: near Kanawha Station. Fayette: near Nuttallburg —L. W. N. Summers: near Hinton.

D. Dillenii, Darl.

Open woodlands. Monongalia, Wood, Marion, Wirt, Upshur, Lewis, Jefferson, Berkeley, Grant and Preston counties. Monroe: near Alderson.

D. paniculatum, (Nutt.), DC.

Copses. Wood, Wirt, Calhoun and Gilmer, along the Little Kanawha River. Monongalia and Marion: along the Monongahela River. Fayette: near Nuttallburg—L. W. N. Summers: near Hinton.

D. Canadense, (L.), DC M. & G.

Dry, but rich woodlands. Monongalia: at The Flats. Marion: near Opekiska. Wood: near Kanawha Station. Mason: Point Pleasant.

D. rigidum, (Ell.), DC.

Dry hillsides. Monongalia: near Morgantown; on Dorsey's Knob. Mineral: along Knobby Mts. Marion: opposite Montana.

D. ciliare, (Muhl.), DC.

Dry hillsides. Monongalia: Cheat View, Little Falls Beechwoods. Marion: near Houghtown. Lewis: near Weston. Upshur: near Buckhannon.

D. Marilandicum, (L.), Boott.

Copses. Grant: near Bayard. Mineral: near Keyser. Berkeley: North Mountain. Morgan: near Hancock. Jefferson: Shenahdoah Jc. Summers: near Hinton.

D. lineatum, (Michx.), DC.

Dry soils. Jefferson: near Shenandale Springs. Gilmer: near Glenville—V. M.

LESPEDEZA, Michx,

L. repens, (L.), Bart. Bush Clover. (*L. procumbens*, Michx.
Dry, sandy soils. Monongalia: hills near The Flats; banks of the Monongahela below Dille's. Wood: near Kanawha Station. Kanawha: Charleston—James. Summers: near Hinton.

L. reticulata, (Muhl.), Pers.
River banks. Fayette: near Nuttallburg, along New River—L. W. N.

L. violacea, (L.), Pers.
Dry copses. Monongalia: near Morgantown. Wood: near Parkersburg. Wirt: near Burning Springs. Fayette: near Nuttallburg—L. W. N. Summers: near Hinton.

L. Virginica, (L.), Britt. (*L. sessiliflora*, Michx.)
River shores. Summers: near Hinton, along New River.

L. Stuvei, Nutt.
Mountain sides. Fayette: near Nuttallburg—L. W. N.

Var. **intermedia,** Watson.
River banks. Fayette: near Nuttallburg, along New River, plentiful—L. W. N.

L. polystachya, Michx.
Dry opens. Fayette: near Nuttallburg, alt. 2000 ft. L. W. N.

L. capitata, Michx.
Dry sandy soils. Ohio River banks, frequent. Monongalia: near Morgantown. Marion: near Catawba, and Houghtown.

L. STRIATA, (Thumb.), Hook. & Arn. Japanese Clover.
Dry, red soils. Spreading profusely along the C. & O. R. R. in Kanawha, Putnam and Cabell counties.

VICIA, L.

V. Caroliniana, Walt. Carolina Vetch or Tare.
River banks and edges of glades. Webster: Welsh Glade; island in Long Glade. Wood: shores of Little Kanawha River. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg—L. W. N. Monongalia: near Cassville.

LATHYRUS, L.

L. venosus, Muhl.

Shady banks. Mineral: banks of the Potomac near Keyser. Fayette: near Nuttallburg, a form 10–15 flowered, with winged stem and stipules 3–15 lines long—L. W. N.

AMPHICARPÆA, Ell.

A. comosa (L.), Ridd. *A. monoica, Ell.*

Rich, damp thickets. Monongalia and Marion: along the Monongahela River. Fayette: near Nuttallburg—L. W. N.

APIOS, Moench.

A. tuberosa, Moench. Ground Nut.

Low Grounds along streams. Frequent throughout the State. Fayette: near Nuttallburg, not common—L. W. N.

PHASEOLUS, L.

P. polystachus, (L.), B. S. P. Wild Kidney Bean. *P. perennis*, Walt.

Copses. Wood: near Kanawha Station. Monongalia: near Morgantown. Mason: near Point Pleasant.

P. helvolus, L. *Strophostyles angulosa,* Ell.

Sandy river banks. Mason: banks of the Ohio near Point Pleasant. Fayette: near Nuttallburg, with the inner surface of the petals pink—L. W. N.

GLEDITSCHIA, L.

G. triacanthos, L. Honey or Black Locust. M. & G.

Rich woods. Monongalia: near Morgantown. Wirt: on Nigh-Cut Hill. Randolph: Rich Mts.; Point Mt., alt. 23-3,700 ft. Gilmer: near Glenville. Hardy: near Moorefield.

CASSIA, L.

C Marilandica, L. Wild Senna. M. & G.

Sandy alluvium. Fayette: near Nuttallburg—L. W. N.; near Gauley Bridge. Gilmer: near Glenville—Prof. Brown. Kanawha: near Pocotaligo. Jackson: near Sandyville. Jefferson: near Harpers Ferry. Mason: near Point Pleasant. Harrison: near Shinnston. Summers: near Hinton. Monongalia: near Morgantown. Hardy: near Moorefield G.

C. Chamæchrista, L. Partridge Pea. M. & G.
Sandy fields. Monongalia: near the mouth of Cheat River. Marion: near Opekiska. Fayette: near Nuttallburg L. W. N.

C. nictitans, L. Wild Sensitive Plant. M. & G.
Sandy places. Monongalia: along the Monongahela River. Marion: near Clements. Fayette: near Nuttallburg—L. W. N. Mason: near Point Pleasant. Summers: near Hinton. Hardy: near Moorefield—G.

CERCIS, L.

C. Canadensis, L. Red-bud. Judas' Tree. M. & G.
Especially common on hillsides along the Great Kanawha River in Putnum and Mason counties. Monongalia: along Cheat River; and the Monongahela. Wirt: along Little Kanawha River. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg—L. W. N. Summers: near Hinton.

GYMNOCLADUS, Lam.

G. dioicus, (L.), Koch. Kentucky Coffee-tree. *G. Canadensis*, Lam. M. & G.
Rich woods, infrequent. Randolph: Point Mountain, beyond Valley Bend. Webster: Buffalo Bull Mountain, along ridge.

ROSACEÆ.

PRUNUS, L.

P Americana, Marsh. Wild Yellow or Red Plum. M. & .G
River banks and woodlands. Monongalia: near Morgantown. Marion: near Opekiska. Tyler: near Long Reach—Col. Johnson. Wood: near Lockhart's Run. Gilmer: near Glenville—V. M.

P. Chicasa, Michx.
Thickets. Monongalia: Permian formations near Cassville. Tyler: near Long Reach.

P. Pennsylvanica, L. f. Wild Red Cherry. V. M., M. & G.
Rocky woods. Very common throughout eastern portion of the State.

P. Virginiana, L. Choke Cherry. V. M., M. & G.
Moist, shady places, common.

P. serotina, Ehrh. Wild Black Cherry. G., L. W. N., V. M., M. & G.
Common throughout the State, where it often forms extensive and very valuable forests. This is especially true of the tree in the central eastern section.

PHYSOCARPA, Raf.

P. opulifolia (L), Raf. Nine-bark.
Along streams, common. Monongalia: along the Monongahela river. Webster: Upper Glade. Fayette: near Nuttallburg—L. W. N. Hardy: near Moorefield.

SPIRAEA, L.

S. betulaefolia, Pall. Birch-leaved Meadow-sweet.
Rich mountain woods. Webster: near Upper Glade. Hardy, near Moorefield--G.

S. Virginiana, Britt. West Virginia Meadow-sweet.
Discovered 1890 along the Monongahela river near Morgantown. The following description is taken from Prof. Britton's account of the plant in "Bull. Torrey Club," Dec. 1890:

"A glabrous shrub, the branches forming long wands, erect or reclining, 1-4 ft. long. Leaves oblong or slightly oblanceolate, thin, obtuse or short-pointed at the apex, rounded or cuneate at the base, $1\frac{1}{2}$ to 2 in. long, 5-8 lines wide, green above, pale beneath, entire or with a few low serrations in the upper half; petioles 2 lines long; pedicels and peduncles pale and glaucous; flowers about 2-lines broad, in terminal compound corymbs 1-3 in. across; calyx teeth 5, triangular, blunt, about the length of the short-campanulate tube, distinctly glaucous; petals 5, white, ovate-orbicular, obtuse; stamens 15-20, persistent; styles 5-6; follicles in the specimens examined, 5-6, apparently sterile, included in the persistent calyx."

"On damp rocks along the Monongahela river, Morgantown, West Virginia, collected by Dr. C. F. Millspaugh in flower, June 20th, 1890, and in apparently imperfect fruit late in September. Collected also by Mr. G. R. Vasey in the mountains of North Carolina, 1878."

"*Spiraea betulaefolia*, Pall. and *S. corymbosa*, Raf., have much longer follicles exerted beyond the calyx, broader, thicker, and dentate leaves, and are different in habit. Rafinesque published a number of species in his New Flora, but none of them can apply to this one."

S. tomentosa, L. Hardhack. Steeple-bush. M. & G.
Low grounds. Webster: Welch Glade. Wood: near Lockhart's Run.

S. rubra, (Mill.) Britt. Queen of the Prairie. *S. lobata*, Jacq.
Meadows. Monongalia: near Morgantown. Preston: near Terra Alta.

S. Aruncus, L. Goat's Beard.
Rich ground and along streams. Monongalia: near Morgantown, Uffington, Little Falls, Day Creek and Granville along the Monongahela. Randolph: along Middle Fork, on Rich Mountains, alt. 2,125 ft. Gilmer: near Glenville—V. M.

GILLENIA, Moench.

G trifoliata, (L.), Moench. Bowman's Root. Indian Physic. M. & G.
Rich woods, frequent. Webster: Welch and Long Glades. Monongalia: along the Monongahela River. Little Falls to Beech Woods. Mineral: near Keyser—W. Summers: near Hinton. Hardy: near Moorefield—G. Mercer: near Ingleside.

G. stipulacea, (Pursh), Nutt. American Ipecac.
Borders of woods. Wood: between Kanawha Station and Lockhart's Run.

RUBUS, L.

R. odoratus, L. Purple-flowering Raspberry. Thimble-berry. M. & G.
Damp rocky places. Monongalia: near Little Falls. Grant: near Bayard. Randolph: near Crickard P. O. Fayette: near Kanawha Falls—James; near Nuttallburg—L. W. N. Summers: near Hinton. Hardy: near Moorefield—G.

Var. **Columbianus**. Columbian Raspberry.
Leaves ample, 5-7-incised, divisions oblong-lanceolate long and taper pointed, sharply and mostly double serrate. Inflorescence smaller and more compact. Fruit smaller than in the species and of a more decided musky taste. Monongalia: cool woods, Tibbs Run.

R. strigosus, Michx. Wild Red Raspberry. M. & G.
Thickets. Fayette: near Nuttallburg, not plentiful—L. W. N. Pocahontas: Spruce Mountain—A. D. Hopkins.

R. occidentalis, L. Black Raspberry. V. M., M. & G., L. W. N.
Frequent throughout the State.

R. villosus, Ait. High Blackberry. L. W. N., V. M., M. & G.
Common everywhere in the State.

Var. **humifusus**, T. &. G.

Woods and river banks. Fayette: near Nuttallburg —L. W. N.

Var. **frondosus**, Torr.

Fayette: near Nuttallburg— L. W. N. Preston: near Tunnellton.

R. Millspaughi, Britt.

This species was described in "The Bulletin of the Torry Club" for 1891, page 366, as follows:

"Ascending, wand-like, entirely unarmed or with a "very few weak prickles above, glabrous throughout or the "younger shoots scurfy pubescent. Stems one and one-half "to four meters long; leaves long petioled, pedately 5-foliate "or some of those on the twigs 3-foliate; leaflets thin, oval, "glabrous on both sides, long-acuminate at the apex, mostly "rounded at the base, 12-15 cm. long, about 5 cm. wide, "sharply, but not deeply serrate; stock of the terminal leaf-"let 7-10 cm. long; inflorescence loosely racemose; bracts "linear-lanceolate; acuminate; fruit black, about 10 mm. "long."

"Nearest to R. villosus, but evidently a distinct species. Curiously enough there is a leaf of this species glued down on the sheet of R. Canadensis, L in herb Linn., and it appears to have been included in his description of that species—the specimens furnished by Kalm."

Near the summit of Point Mountain in Randolph county at an altitude of 3,500 ft., also along the Gandy in great profusion. Pendleton and Pocahontas: on Little Rich Mountains abundant. The mountaineers claim that it is upon this species that the bears grow fat for their period of hibernation, the fruit being late to ripen and very nutritious.

R. Canadensis, L. Dewberry. L. W. N., V. M., M. & G.

Abundant on dry hillsides throughout the State.

Var. **roribaccus**, Bailey. Leucretia Dewberry.

Dry hillsides. Randolph: near Beverly.

This new variety of the species is bescribed by Prof. Bailey in the American Garden, November, 1890, as follows: "Plant larger and stronger; leaflets broad below, usually triangular-ovate, doubly serrate with small teeth, and more or less notched and jagged; peduncles longer, straighter and stouter, habituously more numerous and more conspicuously overtopping the leaves; flowers very large (some times two inches across); sepals uniformly larger, some of them much prolonged and leaf-like and conspicuously lobed (some times becoming an inch long and wide); fruit much larger."

R. hispidus, L. Running Swamp-Blackberry. M. & G.
Glade regions of Preston, Randolph and Webster counties. Fayette: near Nuttallburg—L. W. N.

R. trivalis, Michx. Low Bush-blackberry.
Sandy soil. Kanawha: near Charleston—James.

DALIBARDA, L.

D. repens, L.
Deep mountain woods. Grant: near Bayard. Tucker: along Blackwater Fork of Cheat.

GEUM, L.

G. Canadense, Jacq. *G. album*, Gmel. M. & G.
Woods and thickets. Calhoun, Wood, Grant, Mineral, and Monongalia counties. Fayette: near Kanawha Falls—James; near Nuttallburg—L. W. N. Summers: near Hinton.

G. Virginianum, L.
Borders of woods and low grounds. Wood, Wirt, Calhoun, Gilmer, Marion, Lewis, Monongalia, and Jefferson counties.

G. vernum (Raf.), T. & G.
Moist places. Monongalia: near Morgantown; Little Falls. Marion: near Opekiska.

WALDSTEINIA, Willd.

W. fragarioides, (Michx.), Tratt. Barren Strawberry.
Wooded hillsides. Grant: near Bayard.

FRAGARIA, L.

F. Virginiana, Mill. Wild Strawberry. M. & G.
Moist woodlands and fields, common. Monongalia: near Morgantown—M. H. Brown. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg—L. W. N. Hardy: near Moorefield—G.

F. vesca, L. Northern Wild Strawberry. M. & G.
Shady woods, less common than the last. Kanawha: near Charleston—James. Fayette: near Nuttallburg—L. W. N.

F. Indica, Andr. Indian Strawberry.
Escaped to waste places. Monongalia: near Morgantown. Kanawha: near Charleston—Barnes.

POTENTILLA, L.

P. Norvegica, L. M. & G.
Fields and wet places. Wood: near Kanawha Station. Monongalia: near Morgantown. Grant: near Bayard. Fayette: near Nuttallburg, rare—L. W. N. Tucker—near Davis.

P. Canadensis, L. Cinquefoil. G., L. W. N., V. M., M. & G.
Dry fields, an abundant weed throughout the State.

Var. **simplex** (Michx.), T. & G.
Dry fields. Ohio: near Wheeling—M. & G.

AGRIMONIA, L.

A. Eupatoria, L. L. W. N., M. & G.
Borders of woods, frequent throughout the State.

A. parviflora, Ait.
Woods and glades. Randolph: on Lone Sugar Knob. Preston: near Terra Alta. Webster: Long Glade, Nicholas: Collett's Glade. Tucker: near Davis. Fayette: near Nuttallburg, alt. 2,000 ft.—L. W. N. Summers: near Hinton. Monroe: near Alderson.

POTERIUM, L.

P. Canadense (L.), Gray. Burnet.
Rich, moist woods. Randolph: along Cheat river. Tucker: along Blackwater Fork of Cheat. Monongalia: Cheat river near Camp Eden. Preston: Terra Alta.

ROSA, L.

R. Carolina, L. Carolina Rose. M. & G.
Damp places. Wood: near Kanawha Station, profuse. Upshur: near Buckhannon. Webster: Long Glade. Randolph: meadows along Tygart's Valley river.

R. humilis, Marsh. Dwarf Wild Rose.
Dry soils. Wood: near Kanawha Station. Monongalia: near Uffington and Beechwoods. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg—L. W. N. Summers: near Hinton.

Var. **lucida** (Ehrh.), Best. Larger Wild Rose. (*R. lucida*, Ehrh.) M. & G.
Shaded hillsides. Kanawha: near Charleston—James—Barnes. Monongalia: plentiful along Cheat river above Camp Eden. Fayette: Kanawha Falls—James.

R. RUBIGINOSA, L. Sweet-brier. Elgantine. M. & G.
Frequent along roadsides and thickets. Nicholas: along Gauley river. Randolph: Staunton Pike on Cheat Mountains. Summers: near Hinton. Monongalia: near Ice's Ferry.

R. CANINA, L.
Rocky Banks. Fayette: near Nuttallburg—L. W. N.

PYRUS, L.

P. coronaria, L. Wild Crab Apple. M. & G.
Opens and damp places. Monongalia: frequent about Morgantown. Marion: along the Monongahela river. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg—L. W. N. Mercer: near Beaver Spr.

P. angustifolia, Ait. Narrow-leaved Crab.
Glady regions of Preston, Webster and Nicholas counties.

P. arbutifolia (L.), L. f. Choke Berry.
Damp places. Webster: Upper Glade. Preston: near Terra Alta. Nicholas: Collett's Glade. Fayette: near Nuttallburg, alt. 2000 ft.—L. W. N.

Var. **melanocarpa** (Willd.), Hook.
Preston: Reedsville Glade; Morgans' Glade. Webster: Upper and Welch Glades.

P. Americana, (Marsh.) DC. Mountain Ash. M. & G.
Damp mountain woods. Randolph: near Cheat Bridge. Grant: near Bayard. Tucker: near Davis; and along the Blackwater.

CRATEGUS, L.

C. spathulata, Michx.
Rocky Woods. Mercer: near Beaver Spring, and Wills. McDowell: near Elkhorn.

C. cordata, Ait.
Rocky mountain woods. Mercer: near Beaver Spring, Ada, and Ingleside.

C. OXYACANTHA, L.
River banks. Fayette: near Nuttallburg—L. W. N.

C. apiifolia, Michx.
Rocky woods. Mercer: near Ingleside and at Beaver Spring.

C. coccinea, L. Scarlet Thorn. M. & G.
Thickets. Calhoun: Lower Leading Creek. Monongalia: near Ice's Ferry. Marion: near Opekiska. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg- L. W. N. Upshur: near Buckhannon. Summers: near Hinton. Hardy: near Moorefield—G. Mercer: near Ingleside.

C. mollis (T. & G.), Sarg. *C. coccinea*, var. *mollis*, T. & G.
Mercer: near Beaver Spr. and Ingleside.

C. tomentosa, L. Black Thorn. M. & G.
Uplands. Monongalia: near Stewartstown and Uffington; road to Dorsey's Knob. Randolph: near Cheat Bridge. Tucker: along the Blackwater. Wirt: near Elizabeth. Wood: near Lockhart's Run. Summers: near Hinton. McDowell: near Elkhorn.

C. punctata, Jacq. M. & G.
Borders and open woods. Monongalia: near Ice's Ferry; Cheat River above Camp Eden. Greenbrier: near White Sulphur Springs. Fayette: near Nuttallburg—L. W. N.

C. Crus-galli, L. Cockspur Thorn.
Thickets. Monongalia: frequent. Marion: near Houghtown. Preston: near Reedsville and Terra Alta. Mineral: near Keyser. Jefferson: near Shenandoah Junction. Upshur: near Buckhannon. Fayette: near Nuttallburg—L. W. N. Greenbrier: near White Sulphur Springs. Summers: near Hinton. Hardy: near Moorefield—G. Mercer: near Beaver Springs and Ingleside.

C. flexispina, (Moench.) Sarg. Summer Haw. *C. flava*, Ait.
Shady river banks. Fayette: banks of New River near Nuttallburg—L. W. N. Mercer: near Ingleside. McDowell: along Tug Fork, near Welch.

Var. **pubescens** (Gray).
Sandy woods. Mercer: along stream opposite Wills.

C. uniflora, Moench. *C. parviflora*, Ait.
Sandy woods. Mercer: along streamlet near Ingleside.

AMELANCHIER, Lindl.

A. Canadensis, (L.), Medic. Shad Bush. June Berry. L. W. N., V. M., M. & G., G.
Common generally, even in the higher mountains.

CALYCANTHEÆ.

BEURERA, Ehret.

(*Calycanthus, L.*)

B. florida (L.). Allspice. Sweet-scented Shrub.
Rich woods. Randolph: near Fords; on Staunton Pike, thence frequent over Rich Mountains. Webster and Nicholas: Along Buffalo Bull Ridge. Fayette: along the Gauley river near Gauley Mountains. Summers: near Hinton.

B. laevigatus, (Willd.)
Rich woods. McDowell: back of R. R. water tank near Welsh.

SAXIFRAGEÆ.

ASTILBE, Don.

A. decandra, Don. Goats-beard.
Rich woods. Mercer: near Wills.

SAXIFRAGA, L.

S. Virginiensis, Michx. Early Saxifrage. L. W. N., V. M., M. & G., G.
Exposed moist rocks and opens. General throughout the State.

S. Pennsylvanica, L. Swamp Saxifrage.
Glades. Preston: Morgan's and Terra Alta Glades.

S. micranthifolia (Haw.). Lettuce Saxifrage. *S. erosa*, Pursh. M. & G.
Spring rills in deep woods. Monongalia: near Camp Eden. Grant: near Bayard. Tucker: along the Blackwater.

THEROFON, Raf.

T. aconitifolia (Nutt.). (*Boykinia aconitifolia, Nutt.*)
Creek beds. Fayette: near Nuttallburg; plentiful along the beds of creeks at an alt. of 1800 ft., does not extend down these beds as far as the shores of New river (alt. 1100 ft.). Often 3-celled, sometimes the flowers 6-parted, few 7-parted—L. W. N.

TIARELLA, L.

T. cordifolia, L. False Mitre-wort.

Rich, moist woods. Common throughout the Alleghanies and the foot-hills. Monongalia: near Morgantown. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg—L. W. N. Greenbrier: near White Sulphur Springs. McDowell: near Elkhorn. Mercer: near Bluestone Jc.

MITELLA, L.

M. diphylla, L. Mitre-wort. Bishop's Cap. L. W. N., V. M., M. & G.

Rich, shady woods. Common throughout the State.

HEUCHERA, L.

H. villosa, Michx.

Rocky places. Fayette: Kanawha Falls—James; Loup Creek—James. Nuttallburg—L. W. N. Kanawha: near Coalburg—James.

H. Americana, L. Alum-root. M. & G.

Rich, damp woods. Monongalia: near Morgantown, and frequent elsewhere. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg—L. W. N. Greenbrier: near White Sulphur Springs. Grant: near Bayard. Tucker: near Davis. Hampshire: near Romney.

H. Rugelii, Shuttlw.

Shaded cliffs. Fayette: near Nuttallburg, common—L. W. N.

PARNASSIA, L.

P. grandiflora, DC. *P. Caroliniana*, Michx.

Wet banks. Fayette: near Kanawha Falls—Selby.

HYDRANGEA, L.

H. arborescens, L. Wild Hydrangea. M. & G.

Rich opens. Monongalia: near Morgantown. Marion: Opekiska. Wood: near Kanawha Station. Wirt: near Burning Springs. Gilmer: near Glenville—V. M. Lewis: along Stone Coal Creek. Throughout the above range the flowers were all fertile. Fayette: near Hawk's Nest—James; near Kanawha Falls—James; near Nuttallburg—L. W. N.

A form with grass-green marginal radiant flowers, in a deep ravine in Fayette: near Nuttallburg.

Var. **Kanawhana.**

Low straggling bush, leaves small, paler beneath, acuminate, somewhat cordate at the base; cymes very open and branching, marginal radiant flowers many, 1 in. broad, fertile flowers nearly glabrous, smaller than in the species. Along the Little Kanawha River from Kanawha Station to Glenville.

RIBES, L.

R. Cynosbati, L. Prickly Gooseberry. M. & G.

Deep rocky woods. Randolph: along Cheat River, alt. 3,360 ft.: Point Mountain, alt. 3,700 ft.; Rich Mountain, alt. 2,700. Grant: near Bayard. Preston: near Terra Alta; and frequent throughout the northern and eastern counties. Hardy: near Moorefield.

R. rotundifolium, Michx. Smooth Gooseberry.

Rich, cool, mountain woods, with the last, frequent.

R. prostratum, L., Her.

Pocahontas: summit of Spruce Knob, alt. 4800 ft.—A. D. Hopkins.

R. floridum, L'Her. Wild Black Currant.

Rich woods. Randolph: near Beverly. Grant: near Bayard. Preston: near Terra Alta. Fayette: near Nuttallburg—L. W. N.

CRASSULACEÆ.

SEDUM, L.

S. pulchellum, Michx.

Rocky places. Jefferson: near Harper's Ferry—Asa Gray.

S. Nevii, Gray.

Dry, rocky places. Greenbrier: near White Sulphur Springs.

S. ternatum (Haw), Michx. Stone-crop. G., L. W. N., V. M., M. & G.

On rocks in deep woods and opens. Throughout the State.

S. telephioides, Michx. M. & G.

Drier situations. Throughout the northern counties. Jefferson: Harper's Ferry—Asa Gray. Hardy: near Moorefield—G. Hampshire: near Romney.

S. Telephium, L. Live-for-ever.
Along railroad banks. Jefferson, Morgan and Berkeley counties.

PENTHORUM, L.

P. sedoides, L. Ditch Stone-crop. L. W. N., M. & G.
Open wet places, and ditches. Throughout the State.

DROSERACEÆ.

DROSERA, L.

D. rotundifolia, L. Sundew. M. & G.
Glades. Preston: Cranberry Summit; Morgan's Glade; and Terra Alta.

HAMAMELIDEÆ.

HAMAMELIS, L.

H. Virginica, L. Witch-hazel. L. W. N., V. M., M. & G.
Common in damp woods throughout the State.

LIQUIDAMBAR, L.

L styraciflua, L. Sweet-gum. Alligator-wood. M. & G.
Rich woods. The distribution of this species in the State according to my notes of travel is, from east to west, as follows: Beginning near the source of Peter Creek, in Nicholas county, it follows that stream to its junction with the Gauley river, down this to its confluence with the New river to form the Great Kanawha, which latter it follows to the mouth of Elk river, whence it bears northward up Eight Mile creek to the Pocotaligo and its Middle Fork, across to Mill Creek in Jackson, which it follows to the Ohio.

It is also noted in Gilmer: near Glenville—V. M. Fayette: near Kanawha Falls—James; near Nuttallburg—L. W. N. Cabell: near Huntington—Selby. I have also met with it in Summers: near Hinton; and along the Greenbrier river in that county.

HALORAGEÆ.

CALLITRICHE, L.

C. heterophylla, Pursh.
Fayette: near Nuttallburg—L. W. N.

MELASTOMACEÆ.

RHEXIA, L.

R. Virginica, L. Meadow Beauty.

Moist, sandy meadows, and river shores. Monongalia: near Camp Eden; Little Falls. Wood: near Lockhart's Run. Wirt: near Burning Springs. Upshur: near Lorentz. Randolph: along Tygart's Valley River. Berkeley: near Martinsburg. Putnam: near Buffalo.

LYTHRARIÆ.

CUPHÆA, R. Br.

C. petiolata, (L.), Koehne. "Tar-weed." *C. viscosissima*, Jacq.

Dry soils, and fields. Monongalia, Marion, Wood, Wirt, Calhoun, Gilmer, Lewis, Upshur and Randolph. Fayette: near Gauley Bridge; near Nuttallburg—L. W. N.; near Hawk's Nest—James. Greenbrier: near White Sulphur Springs. Summers: near Hinton. Monroe: near Alderson. Berkeley: near Martinsburg, and elsewhere.

ONAGRARIEÆ.

EPILOBIUM, L.

E. spicatum, Lam. Fire-weed. *E. angustifolium*, L. M. & G.

In new clearings. Mineral: Grant: and Tucker: along the W. Va. Cent. R. R. Randolph: summit of Point Mountain, alt. 3,700 ft. Cheat Mountain, alt. 27-3600 ft. Hardy: near Moorefield—G.

E. coloratum, Muhl. Willow-herb. M. & G.

Ditches, and wet rocks. Greenbrier: near White Sulphur Springs. Fayette: near Nuttallburg—L. W. N. Mason: near Pt. Pleasant; and frequent throughout the State.

LUDWEGIA, L.

L. alternifolia, L. Seed-box. M. & G.

Wet banks. Wood: near Lockhart's Run. Monongalia: along Cheat River near Camp Eden. Fayette: near Kanawha Falls—James; near Nuttallburg—L. W. N.

Var. **linearifolia**, Britt. n. var.

With or near the species. Wood: near Lockhart's Run. Fayette: near Nuttallburg—L. W. N.

Described by Prof. Britton in "Bull. Torrey Club," Dec., 1890, as follows.

"Two or three feet high, divergently branched, the branches ascending. Leaves linear, elongated, 2-4-in. long, 1½-4-lines wide, acute; flowers solitary in the axils of the upper leaves or bracts, yellow; sepals ovate-lanceolate acute, narrower than those of L. alternifolia; branches and both sides of the leaves somewhat pubesent. Petals apparently remaining on the plant longer than those of L. alternifolia, which, as Dr. Millspaugh observes, commonly fall away when the plant is shocked."

"Appearing very distinct from typical L. alternifolia, but presumably but a variety of it. From the description it may be the *Rhexia linearifolia*, Poir, in Lam. Encycl. vi. 2, said to come from Carolina."

L palustris (L.), Ell.

Sandy soil. Fayette: in a Sand bar in New river near Nuttallburg—L. W. N.

OENOTHERA, L.

Oe. biennis, L. Evening Primrose. L. W. N., M. & G.

Frequent or common, throughout the State.

Var. **grandiflora** (Ait.), Lindl.

Frequent. Randolph: Cricard, P. O.; Point Mountain. Wood: near Kanawha Station. Preston: near Tunnellton; near Terra Alta. Greenbrier: near White Sulphur Springs. Hardy: near Moorefield—G.

Oe. pumila, L.

Dry fields, frequent throughout the State, especially in the northern section. Hardy: near Moorefield—G.

Oe. fruticosa, L. Sun-drops. "Wild Beet." M. & G.

Common in most soils, and in cultivated fields as a weed. Summers: near Talcott and Lowell. Marion: near Worthington. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg—L. W. N.

Var. **linearis** (Michx.), Watson.

Damp places. Wood: near Kanawha Station. Wirt: near Elizabeth. Calhoun: near Grantsville. Gilmer: near Glenville—V. M. Upshur: near Buckhannon.

Var. **differta**. Crowded Sun-drops.

Damp meadows. Wood: near Lockhart's Run, the most common form.

Stems 1-2-ft. high, nearly smooth, branching diffusely from every axil. Flowers profuse, large. Lower leaves

ovate. Capsules narrowly winged, very short; apical inflorescence strongly cymose.

GAURA, L.

G. biennis, L. M. & G.

Dry banks. Webster: near Taylor. Greenbrier: near White Sulphur Springs. Fayette: near Nuttallburg—L. W. N. Harrison: near Lumberport. Berkeley: near Martinsburg. Hardy: near Moorefield—G.

CIRCÆA, L.

C. Lutetiana, L. Enchanter's Nightshade. M. & G.

Low grounds, and wet woods. Lewis: up Stone Coal Creek. Gilmer: near Glenville—Prof. Brown. Fayette: near Nuttallburg—L. W. N.

C. alpina, L. M. & G.

Deep, rich woods. Randolph, Grant, Tucker and Pendleton: prevalent in the Alleghanies. Gilmer: near Glenville—V. M. Monongalia: along Cheat river, above Camp Eden.

PASSIFLOREÆ.

PASSIFLORA, L.

P. lutea, L. Yellow Passion-flower.

Hillsides. Fayette: near Nuttallburg—L. W. N.

P. incarnata, L. Passion-flower.

Dry soil. Gilmer: near Glenville—V. M.

CUCURBITACEÆ.

CUCURBITA, L.

C. OVIFERA, L. Gourd.

Escaped to waste grounds. Monongalia: about Morgantown. Jefferson: near Shepherdstown.

CITRULLUS, L.

C. VULGARIS, Schrad. Watermelon.

Escaped to waste grounds. Mason: banks of the Ohio near Point Pleasant.

CUCUMIS, L.

C. Melo, L. Musk Mellon.
Escaped to waste grounds. Mason: banks of the Ohio near Point Pleasant. Monongalia: waste grounds, near Morgantown.

MICRAMPELIS, Raf.

M. echinata, (Muhl.), Raf. (*Echinocystis lobata*, T & G.)
Escaped from gardens, where it is frequently grown as a vine for fences and rock work ornamentation.

SICYOS, L.

S. angulatus, L. Star Cucumber. M. & G.
Damp places. Monongalia: along Decker's Creek; near Easton. Fayette: near Nuttallburg—L. W. N.

CACTACEÆ.

OPUNTIA, Mill.

O. vulgaris, L. Prickly Pear.
Open fields and among scrub pines in the Devonian formations of Hardy: near Moorefield, where it is a prevalent weed in many places.

FICOIDEÆ.

MOLLUGO, L.

M. verticillata, L. Carpet-weed. M. & G.
Waste and cultivated grounds. Monongalia: hills about Morgantown. Marion: near Fairmont. Fayette: near Nuttallburg, sandy banks of New River—L. W. N.

UMBELLIFERÆ.

HYDROCOTYLE, L.

H. Americana, L. Water Pennywort. M. & G.
Along streams. Jefferson: near Flowing Spring. Randolph: above Cricard P. O. Grant: near Bayard. Greenbrier: near White Sulphur Springs.

ERYNGIUM, L.

E. aquaticum, L. Rattle-snake Master. (*E. yuccæfolium*, Michx.)
Swampy places. Webster: at Welsh Glade.

DAUCUS, L.

D. CAROTA, L. Wild Carrot. "Devil's Plague." G., M. & G.
Fields, meadows, and roadsides. Lewis, Randolph, Monongalia, Marion, Berkeley, Morgan, Mineral, Preston, Grant, and Kanawha counties. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg—L. W. N. Jefferson: near Shenandoah Junction; near Charlestown; and Summit Point. Greenbrier: near Caldwell and White Sulphur Springs. Summers: near Greenbrier Stock Yards, and Hinton. Mason: near Point Pleasant. Mercer: near Ingleside; and reported from every county in the State.

Forma **rosea**.
With rose colored flowers, a frequent form in Monongalia: near Morgantown: and along the Kingwood Pike.

ANGELICA, L.

A. Curtisii, Buckley.
Sandy river banks. Monongalia: near Camp Eden. Preston: near Reedsville. Grant: near Bayard. Greenbrier: near White Sulphur Springs.

A. villosa (Walt.), B. S. P. Hairy Angelica. *A. hirsuta*, Muhl.
Frequent in dry woods and glady meadows. Webster: Long and Welsh Glades. Jackson: near Sandyville. Tucker: near Davis. Fayette: near Nuttallburg—L. W. N. Monongalia: near Camp Eden. Preston: near Terra Alta. Randolph: on Point Mountain, alt. 2540 ft. Hardy: near Moorefield—G.

A. atropurpurea, L. Purplish Angelica. *Archangelica atropurpurea*, Hoffm. M. & G.
Low grounds and river banks. Grant: near Bayard. Preston: near Terra Alta. Tucker: near Davis. Fayette: near Kanawha Falls—James.

TIEDEMANNIA, DC.

T. rigida, (L.), Coult. & Rose. Cowbane.
Swampy spots. Randolph: along Shaver's Fork of Cheat. Fayette: near Nuttallburg—L. W. N. Preston: near Terra Alta.

HERACLEUM, L.

H. lanatum, Michx. Cow Parsnip.
Wet grounds. Lewis: along Leading Creek. Upshur: near Lorenz. Randolph: along Tygart's Valley River. Webster: Welsh Glade.

PASTINACA, L.

P. sativa, L. Wild Parsnip. M. & G.

Waste grounds and cultivated fields. Randolph: Cheat Mountains, alt. 3350 ft. Jefferson: near Shenandoah Jc. Greenbrier: near White Sulphur Springs. Mineral: opposite Cumberland. Morgan: near Hancock. Wood: near Kanàwha Station. Mason: near Point Pleasant. Hardy: near Morefield.—G.

THASPIUM, L.

T. aureum, (L.), Nutt. Meadow Parsnip. L. W. N., M. & G.

Thickets and meadows. Frequent throughout the State.

Var. **cordatum**, (Walt.), B. S. P. *var. trifoliatum, Gray*, in pt. M. & G.

With the species, but probably more frequent. Hardy: near Moorefield—G.

T. barbinode, Nutt.

Rich woods. Mercer: plentiful near Bluestone Jc.

LIGUSTICUM, L.

L. actæfolium, Michx.

Rich soil. Grant: near Bayard, plentiful along the Blackwater Fork of Cheat River.

PIMPINELLA, L.

P. integerrima, (L.), Bth. & Hook.

Rocky hillsides. Lewis: along Stone Coal Creek. Randolph: on Point Mountain.

DEERINGIA, Adans. (1763).
(Cryptotænia, DC. 1829)

D. Canadensis, L. Honewort. *Cryptotænia Canadensis (L.) DC.* M. & G.

Shady rocks. Monongalia: Roundbottoms and Little Falls. Marion: near Opekiska. Fayette: near Nuttallburg —L. W. N.

ZIZIA, Koch.

Z. cordata, Koch,

River banks. Fayette: near Nuttallburg—L. W. N.

Z. aurea, Koch.

Damp places. Monongalia: The Flats, and along the Monongahela. Marion: near Opekiska. Fayette: near Nuttallburg—L. W. N.

Z Bebbii, C. & R. *Z. aurea*, var. *Bebbii*, C. & R.

Woodlands. Fayette: near Nuttallburg—L. W. N.

Of specimens gathered in Mason, near Pt. Pleasant, Prof. Coulter says: "Flowers too white, and altogether it does not quite fit, and is indeterminable on account of the immature fruit."

CICUTA, L.

C. maculata, L. Spotted Cow-bane. Beaver Poison.

Swampy spots, and wet meadows. Randolph: along Tygart's Valley River plentiful. Fayette: along Loup Creek—James: near Nuttallburg—L. W. N. Putnam: near Scott's Depot—James. Gilmer: Glenville—Prof. Brown; near DeKalb P. O. Morgan: near Cacapon. Monongalia: near Ice's Ferry. Mason: near Point Pleasant.

C. bulbifera, L.

Wet places. Mason: near Pt. Pleasant.

CHÆROPHYLLUM, L.

C. procumbens, (L.) Crantz.

Ohio: Elm Grove, near Wheeling—M. & G.

OSMORHIZA, Raf.

O. Claytoni (Michx.), B. S. P. *O. brevistylis, DC.* M. & G.

Rich woods. Wirt: above Elizabeth. Gilmer: near Glenville—V. M.; Prof. Brown. Monongalia: opposite Roundbottoms. Grant: near Bayard. Fayette: near Nuttallburg—L. W. N.

O. longistylis (Torr.), DC. M. & G.

Rich Woods. Monongalia: near Morgantown. Marion: near Fairmont. Tucker: near Davis. Wirt: above Elizabeth.

ERIGENIA, Nutt.

E. bulbosa, Nutt. Harbinger of Spring. M. & G.

Rich open woods. Monongalia: opposite Granville, plentiful. Fayette: near Nuttallburg—L. W. N.

SANICULA, L.

S. Marylandica, L. Black Snake-root. M. & G.
Rich woods. Monongalia: near Morgantown. Preston: near Terra Alta. Fayette: near Nuttallburg—L. W. N.

S. Canadensis, L. M. & G.
Rich soil. Monongalia: near Little Falls. Marion: near Opekiska. Fayette: near Nuttallburg—L. W. N.

ARALIACEÆ.

ARALIA, L.

A. spinosa, L. Angelica Tree. Hercules' Club. M. & G.
Rich mountain woods. Webster: Buffalo Bull Mt. alt. 2595 ft., plentiful. Preston: near Rowlesburg. Summers: along the Greenbrier River; near Hinton. Fayette: near Nuttallburg—L. W. N.; at Gauley Bridge, abundant. Monongalia: near Morgantown.

A. racemosa, L. Spikenard. M. & G.
Deep, cold woods, frequent in the Alleghanies. Randolph: Cheat Mountains, alt. 3350 ft.; Point Mountain, alt. 3560 ft. Hampshire: Ice Mountain. Tucker: near Falls of Blackwater. Gilmer: near Glenville—V. M. Greenbrier: near White Sulphur Springs. Fayette: near Nuttallburg—L. W. N. Summers: near Hinton.

A. nudicaulis, L. Wild Sarsaparilla. M. & G.
Rich woods, frequent. Monongalia: the Flats, Rich Woods, and along the Monongahela. Marion: near Opekiska. Randolph: on Point Mountain. Grant: near Bayard.

A. quinquefolia (L.), Dec. & Pl. Ginseng. "Sang." M. & G.
Rich, deep woods. Wirt: near Burning Springs. Jackson: near Ripley. Gilmer: near Glenville—V. M. Grant: near Bayard. Randolph: Rich, Cheat and Point Mountains. (One store at Crickard P. O. buys from this neighborhood $1,500 worth annually of the mountaineers.) Webster: Buffalo Bull range. Fayette: near Nuttallburg—L. W. N. Summers: near Hinton.

A. hispida, Vent.
Rocky soils. Tucker: near Davis, along Blackwater Fork of Cheat.

CORNACEÆ.

CORNUS, L.

C. florida, L. Flowering Dogwood. M. & G.

Dry woods. Monongalia throughout, some quite large trees near Morgantown. Wood, Wirt and Calhoun counties. Gilmer: near Glenville—Prof. Brown;—V. M. Lewis and Upshur counties. Randolph: on Cheat Mountains, alt. 3600 ft. Marion: Webster: Fayette: near Nuttallburg—L. W. N. Hardy; near Moorefield—G. Mercer: near Bluefield.

C. circinata, L'Her. Round-leaved Dogwood.

Damp, cool woods. Rare. Upshur: near Lorentz.

C. sericea, L. Kinnikinnik.

Wet places. Grant: near Bayard. Randolph: along Tygart's Valley River. Nicholas: along Peter Creek. Fayette: near Nuttallburg—L. W. N.

C. candidissima, Marsh. Panicled Cornel. *C. paniculata*, L'Her.

Thickets and river banks. Monongalia: near Morgantown. Marion: Montana; along Beaver Creek. Randolph: Cheat River, alt. 2700 ft. Summers: near Hinton. Hampshire: near Romney.

C. alternifolia, L. f.

Hillside copses. Monongalia, Marion, Preston, Wood and Calhoun counties. Gilmer: near Glenville—V. M. Lewis: along Leading Creek. Upshur: near Lawrence. Fayette: near Nuttallburg—L. W. N. Greenbrier: near White Sulphur Springs. Summers: near Hinton.

NYSSA, L.

N. sylvatica, Marsh. Black Gum. M. & G.

Various situations throughout the State. Wood: near Leachtown. Wirt: along Straight Creek. Calhoun: near Brookville. Gilmer: near Glenville—V. M. Monongalia: near Morgantown. Randolph: on Point Mountain. Webster: on Buffalo Bull Mountains. Fayette: near Nuttallburg—L. W. N. Summers: near Hinton; and along the Greenbrier River. Kanawha: near Handley. Mercer: near Ingleside.

CAPRIFOLIACEÆ.

SAMBUCUS, L.

S. Canadensis, L. Common Elder. L. W. N., V. M., M. & G.
Rich soils; common in bottoms and along fences throughout the State; even in the pine and spruce forests of the higher mountains; altitude on Point Mountain 3050 ft.

S. racemosa, L. Red-berried Elder. M. & G.
Deep, rich mountain woods, near rivulets. Abundant in Randolph, Grant and Tucker counties. Fayette: near Nuttallburg—L. W. N.

Forma **albicocca,** Britt.
With the species rare. Randolph: on Point Mountain. Grant: near Bayard.

VIBURNUM, L.

V. lantanoides, Michx. Hobble-bush.
Cold, rich ravines. Randolph: near the summit of Point Mountain. Grant: near Bayard. Tucker: along the Blackwater.

V. acerifolium, L. Arrow Wood. Dockmackie. M. & G.
Cool, rocky woods. Throughout the mountains of the eastern counties. Preston and Monongalia: along Cheat River. Gilmer: near Glenville—V. M. Mineral: near Keyser—W. Fayette: near Nuttallburg—L. W. N. Grant: near Bayard.

V. dentatum, L. Arrow-wood.
Wet places or damp thickets. Upshur: near the Summit on Staunton Pike. Fayette: near Nuttallburg, rare—L. W. N.

V. nudum, L.
Rich woods. Randolph: at Ford's, near the Middle Fork River. Webster: Upper Glade.

V. Lentago, L. Sweet Viburnum. Sheep-berry.
Rich banks of streams. Randolph: on Point Mountain, alt. 3660 ft.

V. prunifolium, L. Black Haw. Nanny-berry.
Copses and edges of woods. Wirt: near Burning Springs. Mineral: near Keyser—W. Gilmer: near Glenville—V. M.; Prof. Brown. Fayette: near Nuttallburg—L. W. N. Summers: near Hinton.

TRIOSTEUM, L.

T. perfoliatum, L. Tinker's Weed. Wild Coffee.
Rich borders, infrequent. Randolph: Cheat Mts., alt. 4,600 feet. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg—L. W. N. Hardy: near Moorefield—G. Mercer: near Princeton.

SYMPHORICARPOS, Juss.

S. orbiculatus, Moench. *S. vulgaris*, Michx.
Dry places. Nicholas: near Peter Creek. Fayette: near Nuttallburg, alt. 2,000 ft.—L. W. N.

LONICERA, L.

L. glauca. Hill. Smooth Honeysuckle. *L. parviflora*, Lam.
Rocky soils. Monongalia: near Morgantown.

L. JAPONICA, Thunb.
Escaped from cultivation. Mason: banks of the Ohio near Pt. Pleasant. Jefferson: near Shepherdstown. Taylor: near Grafton.

DIERVILLA, Tourn.

D. trifida, Moench. Bush Honeysuckle.
Thickets. Monongalia: near Morgantown, along Decker's Creek.

RUBIACEÆ.

HOUSTONIA, L.

H. cærulea, L. Bluets. Innocents. M. & G.
Moist fields. Monongalia: Marion: Preston: Wood: Wirt: Calhoun: Lewis: and Upshur. Gilmer: near Glenville—Prof. Brown—V. M. Kanawha—James. Mineral: Jefferson: Berkeley: and Morgan. Fayette: near Nuttallburg—L. W. N. Hardy: near Moorefield—G.

Forma **albiflora**.
Grassy places, Permian formations. Monongalia: near Cassville.

H. serpyllifolia, Michx.
Rocky places. Tucker: rocks below the falls of Blackwater. Monongalia: on rocks in Tibb's Run.

H. purpurea, L.
Wooded opens. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg—L. W. N.; Kanawha Falls—James. Hampshire: near Romney. Greenbrier: near White Sulphur Springs. Summers: near Hinton. Monongalia: near Ice's Ferry.

Var. **ciliolata**, Gray.
Monongalia: near Morgantown. Fayette: near Nuttallburg—L. W. N. Greenbrier: near White Sulphur Springs.

Var. **longifolia** (Gaertn.), Gray. M. & G.
Dry soils, the most common form of the species. Wood: near Lockhart's Run. Wirt: near Burning Springs. Calhoun: near Grantsville. Gilmer: near DeKalb. Lewis: up Stone Coal Creek. Upshur: near Buckhannon. Randolph: near Cricard P. O. Cabell: near Barboursville—James. Fayette: near Nuttallburg—L. W. N. Mercer: near Bluefield.

Var. **tenuifolia**, Gray.
Greenbrier: near White Sulphur Springs.

Var. **calycosa**, Gray.
Greenbrier: near White Sulphur Springs.

CEPHALANTHUS, L.

C. occidentalis, L. Button-bush. M. & G.
Along streams. Monongalia: along the Monongahela and Cheat Rivers. Preston: general in the glades and along streams. Grant: near Bayard. Randolph: along Tygart's Valley River; near Cheat Bridge. Fayette: near Nuttallburg L. W. N.; near Kanawha Falls—James. Monroe—near Alderson. Summers: near Riffe and Hinton.

MITCHELLA, L.

M. repens, L. Partridge-berry. M. & G.
Rich woods, under evergreens. Upshur: Sand Creek. Grant: near Bayard. Tucker: along Blackwater. Mineral: Knobby Mts.—W. Randolph: along Cheat River. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg—L. W. N. Kanawha: near Coalburg—James.

DIOIDA, L.

D. teres, Walt. Button-weed.
Sandy river banks. Ohio: along Bogg's Rnn, near Wheeling—M. & G. Preston: banks of Cheat River. Fayette: near Nuttallburg, rare—L. W. N.

GALIUM, L.

G. Aparine, L. Goose-grass. Cleavers. G., L. W. N., V. M., M. & G.
Shaded places. Frequent throughout the State.

G. pilosum, Ait.
Dry copses. Fayette: near Nuttallburg—L. W. N.; near Kanawha Falls—James. Kanawha: near Coalburg—James. Monongalia: near Little Falls and Uffington; near Camp Eden.

G. circæzans, Michx. Wild Liquorice.
Rich woods. Wood: near Lockhart's Run. Monongalia: Rich Woods near Morgantown; Ice's Ferry and Camp Eden. Fayette: near Nuttallburg—L. W. N.

G. laceolatum, Torr.
Dry woods. Monongalia: near Morgantown. Ohio: near Wheeling—M. & G. Fayette: near Nuttallburg—L. W. N.

G. latifolium, Michx.
Fayette: near Nuttallburg, uncommon—L. W. N. Preston: near Rowlesburg—M. & G.

G. trifidum, L. Small Bedstraw.
Low, wet grounds. Monongalia, Lewis, Upshur, Gilmer, Calhoun, Wirt, Wood, and Webster: Long Glade. Fayette: near Nuttallburg—L. W. N.

Var. **latifolium,** Torr.
Damp soils. Webster: in Long Glade.

G. concinnum, Torr & Gray. M. & G.
Low, wet grounds. Wood: near Kanawha Station. Wirt: near Elizabeth. Lewis: along Leading Creek. Randolph: near Valley Bend.

G. asprellum, Michx. Rough Bedstraw.
Alluvial bottoms. Monongalia: along the Monongahela River. Greenbrier: near White Sulphur Springs—M. & G.

G. triflorum, Michx. Sweet-scented Bedstraw.

Rich woodlands. Lewis: along Leading Creek. Upshur: near Lorentz. Webster: along Buffalo Bull range. Monongalia: near Morgantown. Fayette: near Nuttallburg—L. W. N.

VALERIANACEÆ.

VALERIANA, L.

V. pauciflora, Michx. Valerian.

Fields and open woods. Ohio: near Moundsville—M. & G.

DIPSACEÆ.

DIPSACUS, L.

D. SYLVESTRIS, Mill. Teasel. "Water Thistle." "Huttonweed." M. & G.

Roadsides and waste places. Wirt: near Burning Springs and Elizabeth. Marion: near Worthington; near Fairmont and Houghton in great quantity. Webster: Buffalo Bull Mountains, alt. 2100 ft. Fayette: near Crescent; near Nuttallburg—L. W. N. Kanawha: along the Kanawha and Pocotaligo Rivers. Jackson: along Allen's Fork. Gilmer: near Glenville—V. M. Jefferson: near Flowing Spring and Shenandoah Jc. Randolph: Cheat Mts. near Cheat Bridge, alt. 2700 ft.; near Huttonsville. Greenbrier: near White Sulphur Springs, near Fort Spring. Monroe: near Alderson. Summers: near Hinton. Monongalia: along Decker's Creek. Harrison: near Lumberport. Mineral: opposite Cumberland. Berkeley: near Martinsburgh. Hardy: near Moorefield. Mercer: near Ingleside, and Ada.

COMPOSITÆ.

ELEPHANTOPUS, L.

E. Carolinianus, Willd.

Dry banks. Fayette: near Nuttallburg—L. W. N.

E. tomentosus, L. "Tobacco Weed." "Devil's Grandmother."

Fields. Harrison: near Quiet Dell. Upshur: near Lorentz.

VERNONIA, Schreb.

V. altissima, Nutt. Iron-weed

Low grounds. A frequent weed throughout the northern, central, and western portions of the State. Fayette: near Nuttallburgh—L. W. N.

V. Noveboracensis (L.), Willd. Iron Weed. G., L. W. N., M. & G.

In meadows and pastures, common throughout the State.

Var. **latifolia,** Gray.

Meadows and fields. Mason: near Point Pleasant. Monongalia: near Morgantown. Fayette: near Nuttallburg —L. W. N.

EUPATORIUM. L.

E. purpureum, L. Queen of the Meadow. "Quill-wort." L. W. N. V. M., M. & G., G.

Low grounds. Common throughout the State. Cheat Mountains in Randolph at an altitude of 3600 feet.

Var. **amœnum,** Gray.

Rich woods along runs. Grant: Buffalo Creek near Bayard. Tucker: Beaver Creek near Davis.

E. hyssopifolium, L.

Sterile soil. Jefferson: near Shepherdstown.

E. rotundifolium, L., *var.* **pubescens.** (Muhl.), B. S. P. (*E. pubescens*, Muhl.)

Dry hillsides. Fayette: near Nuttallburg—L. W. N. Jefferson: near Shepherdstown. Monongalia: near Morgantown and Camp Eden.

E altissimum, L. Tall Boneset.

Dry soils. Monongalia: near Little Falls and Beechwoods.

E. sessilifolium, L. Upland Boneset.

River banks. Monongalia: near Beechwoods. Fayette; near Nuttallburg, plentiful—L. W. N.

E. perfoliatum, L. Boneset. Thorough-wort. G., L. W. N., V. M., M. & G.

Damp places. Common throughout the State.

E. ageratoides, L. White Snake-root.

Rich woods. Monongalia: along Decker's Creek and elsewhere plentiful. Randolph: Cheat Mountains near Cheat Bridge. Marion: near Worthington. Fayette: near Nuttallburg—L. W. N. Hardy: near Moorefield—G.

E. aromaticum, L.

Rich soil. Fayette: near Nuttallburg. Hardy: near Moorefield—G.

E. cœlestinum, L. Mist-flower. M. & G.

Rich soils. Putnam, Jackson, Wood and Monongalia. A common weed. Randolph: along Tygart's Valley River. Harrison: along the "Monongah" R. R. Summers: near Hinton. Fayette: near Nuttallburg—L. W. N. Putnam: near Buffalo. Kanawha: near Charleston. Mason: near Point Pleasant. Marion: near Montana and Worthington. Jefferson: near Shepherdstown.

LACINARIA, Hill (1762).
Liatris, Schreb. (1791).

L. spicata, (L.), OK.

Among rocks, banks of New River—Selby. Fayette: near Nuttallburg, heads 5-flowered—L. W. N.

CHRYSOPSIS, Nutt.

C. Mariana (L.), Nutt.

Dry, rocky roadside. Fayette: R. & K. turnpike near Nuttallburg—L. W. N.

SOLIDAGO, L.

S. latifolia, L. M. & G.

Moist, shaded banks. Monongalia: banks of the Monongahela and Cheat River. Fayette: near Nuttallburg—L. W. N.

S. cæsia, L. L. W. N., V. M., M. & G.

Rich woodlands. Frequent throughout the State.

S. Curtisii, Torr. & Gray.

Woodlands. Fayette: near Nuttallburg, common—L. W. N.

S. bicolor, L. L. W. N., M. & G.

Dry fields and copses. Frequent throughout the State.

S. monticola, Torr. & Gray.
Woods and opens. Fayette: near Nuttallburg, alt. 2000 ft—L. W. N.

S. puberula, Nutt.
Sunny opens. Fayette: near Nuttallburg—L. W. N.

S. speciosa, Nutt.
Cliffs and banks. Fayette: near Nuttallburg—L. W. N.

S. odora, Ait Sweet Golden-rod.
Fayette: near Nuttallburg—L. W. N.

S. rugosa, Mill.
Borders of fields and copses. Along Cheat River. Randolph, Tucker, Preston and Monongalia counties. Fayette: near Nuttallburg—L. W. N. Shores of the Monongahela in Barbour, Taylor and Marion counties.

S. ulmifolia, Muhl.
River banks. Ohio: Thomas Hill near Wheeling—M. & G. Brooke: M. & G. Fayette: near Nuttallburg—L. W. N.

S. Boottii, Hook.
Dry open woods. Putnam: near Buffalo. Fayette: near Nuttallburg—L. W. N.

S. arguta, Ait.
River banks. Ohio: banks of the Ohio River near Wheeling—M. & G.

S. juncea, Ait. "Yellow Top."
Fields and waste places. Common throughout the northern, central and western counties. Fayette: near Nuttallburg—L. W. N. Berkeley: near Martinsburg. Mason: near Point Pleasant. Hardy: near Moorefield—G.

Var. **scabrella**, Gray.
With the species. Frequent.

Var. **ramosa,** Britten.
River banks. Monongalia: near Morgantown, below highwater mark along the Monongahela.

S. serotina, Ait.
Fayette: near Nuttallburg—L. W. N. Monongalia: near Morgantown.

Var. **gingantea**, (Ait.), Gray.
Thickets. Gilmer: near Glenville—V. M. Preston: near Rowlesburg.

S. **rupestris**, Raf.
Rocky river banks. Fayette: along the Gauley at Gauley Mountain; Kanawha Falls and Hawk's Nest—James.

S. **Canadensis**, L. L. W. N., M. & G.
Borders and waste fields. Common throughout the State.

S. **nemoralis**, Ait.
Dry, sterile fields. Fayette: near Nuttallburg—L. W. N. Common throughout the northern counties.

S. **lanceolata**, L.
River banks. Along Cheat River tnroughout its length. Along the Monongahela in Marion, Taylor and Monongalia counties. Gilmer: along the Little Kanawha—V. M. Mason: near Point Pleasant.

S. **Caroliniana**, (L.), B. S. P. *S. tenuifolia*, Pursh.
Sandy fields. Monongalia: near Morgantown.

SERICOCARPUS, Nees.

S. **asteroides** (L.), B. S. P. White-topped Aster. M. & G.
Dry grounds. Frequent or common throughout the State. Kanawha: near Charleston—James. Greenbrier: near White Sulphur Springs. Fayette: near Nuttallburg—L. W. N.

BRACHYCHÆTA, T. & G.

B. **cordata**, Torr. & Gray.
Dry woods. Fayette: near Nuttallburg, plentiful—L. W. N.

ASTER, L.

A. **corymbosus**, Ait. M. & G.
Shady places. Monongalia: near Morgantown. Fayette: near Nuttallburg—L. W. N.

A. **macrophyllus**, L.
Open woods. Fayette: near Nuttallburg—L. W. N.

A. **patens**, Ait.
Rocky river banks. Fayette: near Nuttallburg—L. W. N. Summers: near Hinton.

Var. **phlogifolius**, (Muhl.), Nees.
Open woods. Fayette: near Nuttallburg—L. W. N.

A. lævis. L.
Rocky river banks. Monongalia: near Little Falls. Fayette: near Nuttallburg, plentiful—L. W. N.

A. undulatus. L.
Dry woods. Mason: near Point Pleasant. Kanawha: near Charleston. Fayette: near Nuttallburg, common—L. W. N.

A. cordifolius, L.
Woodlands. Monongalia: near Morgantown and Little Falls. Fayette: near Kanawha Falls—James; near Nuttallburg—L. W. N. Mason: near Point Pleasant.

Var. **lævigatus**, Porter.
Woodlands and opens. Monongalia: near Morgantown, abundant.

A. virgatus, Ell.
Rocky river banks. Fayette: near Nuttallburg—L. W. N. Preston: along Cheat River. Monongalia: near Camp Eden.

A. ericoides. L.
Dry open places. Fayette: near Nuttallburg—L. W. N. Mason: near Point Pleasant. Wood: near Parkersburg. Monongalia: near Morgantown.

Var. **pusillus**, Gray.
Dry fields. Monongalia: plentiful about Morgantown.

Var. **villosus**, Torr. & Gray
Roadsides, etc. Fayette: near Nuttallburg, common—L. W. N. Monongalia: near Morgantown. Marion: near Fairmont.

A. lateriflorus, (L.), Britt. (*A. miser*, Man. *A. diffusus*, Ait.
Dry or moist grounds: Monongalia: near Morgantown. Frequent throughout the northern counties. Hardy: near Moorefield—G.

Var. **hirsuticaulis**, (Lind.), "Nail-rod."
Fields and roadsides. Cabell: near Barboursville. Monongalia: near Morgantown; and common throughout the northern, central and western counties.

A. multiflorus, Ait.
Hardy: near Moorefield—G.

A. dumosus, L.
Hardy: near Moorefield—G.

A. vimineus, Lam.
Shaded roadsides and fields. Fayette: near Nuttallburg, altitude 2000 ft., plentiful—L. W. N. Monongalia: near Morgantown. Mason: near Point Pleasant.

Var. **foliolosus**, Gray.
Monongalia: near Morgantown, Uffington and Little Falls, common.

A. paniculatus, Lam. (*A. simplex*, Willd.)
Low grounds. Fayette: near Nuttallburg—L. W. N. Mason: near Point Pleasant. Putnam: near Buffalo.

A. salicifolius, Ait.
Near streams. Monongalia and Preston: banks of Cheat River.

A. Novi-Belgii, L.
Damp meadows. Monongalia: near Morgantown.

A. prenanthoides, Muhl.
Rich woods and borders of streams. Randolph: Cheat Bridge, alt. 3360 ft. Monongalia: shore of Monongahela above Morgantown. Fayette: near Nuttallburg—L. W. N.

A. puniceus, L.
Swampy places. Fayette: near Nuttallburg, uncommon—L. W. N. Hardy: near Moorefield—G.

A. umbellatus, Mill.
Moist thickets. Along Cheat River in Randolph, Tucker, Preston and Monongalia counties. Fayette: near Nuttallburg—L. W. N.

A. infirmus, Michx.
Mountain woods. Randolph: Point Mountain, alt. 2800 ft. Fayette: near Nuttallburg—L. W. N.

A. acuminatus, Michx.
Cool, rich woods. Randolph: near Cheat Bridge. Fayette: near Kanawha Falls—James.

[**A. tenuifolius**, L. (*A. flexuosus*, Nutt.) M. & G.]

A. linariifolius, L.

Rocky places. Fayette: near Nuttallburg, along the banks of New River below high water mark, common—L. W. N.

ERIGERON, L.

E. Canadensis, L. Butter-weed. Horse-weed. L. W. N., V. M., M. & G.

Waste places. Common throughout the State.

E. annuus, (L.), Pers. Daisy Fleabane. Sweet Scabious. L. W. N., V. M., M. & G.

A weed in meadows and fields. Common through out the State.

E. ramosus (Walt.), B. S. P. Daisy Fleabane. (*E. strigosus*, Muhl.)

Fields and waste places. Monongalia: the Flats and Uffington. Fayette: Nuttallburg - L. W. N.

E. pulchellus, Michx. Robin's Plantain. (*E. bellidifolius*, Muhl.) L. W. N., M. & G.

Copses, common throughout the State.

E. Philadelphicus, L. Common Fleabane.

Moist ground. Frequent throughout the northern counties.

ANTENNARIA, Gærtn.

A. plantaginifolia (L.), Hook. Everlasting. L. W. N., M. & G.

Sterile hills. Frequent or common throughout the State.

ANAPHALIS, DC.

A. margaritacea (L.), Bth. & Hook. Pearly Everlasting. M. & G.

Dry hills and woods. Monongalia: along Decker's Creek. Marion: above Opekiska.

GNAPHALIUM, L.

G. obtusifolium, L. Everlasting. *G. polycephalum*, Michx. M. & G.

Old fields. Frequent or common throughout the northern and central counties. Fayette: near Nuttallburg—L. W. N. Hardy: near Moorefield—G.

G. ulignosum, L. Low Cud-weed. M. & G.
Low grounds. Grant: near Davis. Gilmer: near Glenville—V. M., Prof. Brown. Monongalia: near Morgantown. Mason: near Point Pleasant. Wood: near Parkersburg.

G. purpureum, L. Purplish Cud-weed.
Sandy soil. Monongalia: near Beechwoods and Ice's Ferry. Fayette: near Nuttallburg—L. W. N.

INULA, L.

I. HELENIUM, L. Elecampane. M. & G.
Fields. Wirt: near Burning Springs. Upshur: near Lorentz. Nicholas: along Mumble-the-peg Creek. Fayette: near Nuttallburg—L. W. N. Greenbrier: near Ronceverte. Jefferson: near Shepherdstown. Hampshire: near Romney. Monongalia: near Stumptown.

POLYMNIA, L.

P. Canadensis, L. Leaf Cup. M. & G.
Moist shaded ravines. Fayette: near Kanawha Falls and Hawk's Nest—James; Porter; near Nuttallburg—L. W. N. Hardy: near Moorefield—G.

Var. **radiata**, Gray.
Rich rocky soil. Fayette: near Nuttallburg—L. W. N.

P. Uvedalia, L.
Rich soil. Randolph: frequent along Tygart's Valley River. Fayette: near Nuttallburg—L. W. N.

SILPHIUM, L.

S. Asteriscus, L.
Dry sandy soil. Wirt: beyond Burning Springs. Jackson: near Ripley.

S. trifoliatum, L. Rosin-weed.
Dry hills and banks. Fayette: near Nuttallburg—L. W. N.

S. perfoliatum, L. Cup Plant.
Along streams. Fayette: near Hawk's Nest—James; near Nuttallburg—L. W. N.

CHRYSOGONUM, L.

C. Virginianum, L.
Dry soils. Hardy: near Moorefield—G.

PARTHENIUM, L.

P. integrifolium, L. Sneeze-wort.
Dry soils. Fayette: near Nuttallburg, banks of New River below high water mark, plentiful—L. W. N. Greenbrier: near White Sulphur Springs—M. & G.

AMBROSIA, L.

A. trifida, L. Great Rag-weed. G., L. W. N., M. & G.
Moist places. Common or abundant throughout the State.

Var. **integrifolia,** (Muhl.), T. & G.
With the species, uncommon. Monongalia: near Morgantown. Wood: near Parkersburg. Fayette: near Nuttallburg—L. W. N. Berkeley: near Martinsburg.

A. artemisiæfolia, L. Rag-weed. G., L. W. N., V. M., M. & G.
Fields and roadsides. Abundant throughout the State.

XANTHIUM, L.

X spinosum. L. Spiny Clotbur.
Waste lands along rivers. Kanawha: at Stockton's. Mineral: near Piedmont. Jefferson: near Shepherdstown. Wood: near Parkersburg. Berkeley: near Martinsburg.

X. Strumarium, L. Clotbur. Cockle-bur.
Low waste grounds. Monongalia, Marion and Gilmer counties. Wood: near Parkersburg. Lewis: near Weston. Jefferson: near Shepherdstown.

X. Canadense, Mill. L. W. N.
Low waste grounds. Common throughout the State.

ECLIPTA, L.

E. alba, (L.), Hassk. (*Eclipta procumbens,* and *E. erecta,* Michx.)
Wet river banks. Mason: banks of the Ohio near Point Pleasant. Ohio: near Wheeling—M. & G. Fayette: R. R. bank, Nuttallburg—L. W. N.

HELIOPSIS, Pers.

H. scabra, Dunal. Ox-eye.
Fields. Gilmer: near Glenville—V. M.

H. lævis, Pers.
Fayette: near Nuttallburg—L. W. N.

ECHINACEA, Moench.

E. PURPUREA, Moench. Purple Cone-flower.
Along the C. & O. R. R. Fayette: near Nuttallburg; a rough, bristly form—L. W. N. Adventive from the west.

RUDBECKIA, L.

R. laciniata, L. Cone-flower. M. & G.
Low grounds. Monongalia: Little Falls, Beechwoods, Uffington, and Morgantown. Fayette: near Nuttallburg—L. W. N.

Var. **humilis**, Gray.
Monongalia: banks of Monongahela River below Morgantown.

R. fulgida, Ait.
Fields and Meadows. Monroe: abundant near Alderson. Hardy: near Moorefield - G.

R. triloba, L. Brown-eyed Susan. M. & G.
Dry fields. Gilmer: near Glenville—V. M. Greenbrier: near White Sulphur Springs.

R. HIRTA, L. "Nigger Head." "Yellow Daisy." Brown-eyed Susan. M. & G.
Becoming too frequent in Meadows. Randolph: Criccard P. O. Throughout the Ohio River counties. Fayette: along Loup Creek—James, 1887; near Nuttallburg—L. W. N. Wood: near Kanawha Station.

R. speciosa, Wender.
Dry soils. Ohio: near Wheeling—M. & G.

HELIANTHUS, L.

H. lætiflorus, Pers.
Dry Opens. Fayette: near Nuttallburg.

H. occidentalis, Riddell. Western Sunflower.
Banks of New River. Fayette near Nuttallburg, infrequent—L. W. N.

Var. **Dowellianus**, T. & G.
Dry soils. Fayette: near Nuttallburg—L. W. N.

H. tomentosus, Michx.
Banks of New River. Fayette: near Nuttallburg—L. W. N.

H. grosse-serratus, Martens. Large-toothed Sunflower.
Dry fields. Upshur: near Buckhannon.

H. giganteus, L. Giant Wild Sunflower.
Low grounds. Randolph: near Cheat Bridge. Fayette: near Nuttallburg, plentiful—L. W. N. Preston: near Terra Alta.

H. lævigatus, Torr. & Gray.
Thickets. Preston: near Terra Alta.

H. doronicoides, Lam.
Dry grounds. Ohio: on Bogg's Island.—M. & G. Hardy: near Moorefield—G.

H. parviflorus, Bernh.
Thickets. Summers: near Hinton. Greenbrier: near White Sulphur Springs. Fayette: near Nuttallburg—L. W. N. Preston: near Terra Alta.

H. divaricatus, L.
Thickets and dry places. Fayette: near Nuttallburg—L. W. N. Jackson: up 8 mile creek.

H. hirsutus, Raf.
Dry banks. Fayette: near Nuttallburg, rare—L. W. N. Mason: Banks of the Ohio near Point Pleasant. Hardy: near Moorefield—G.

H. strumosus, L.
River banks and low copses. Monongalia: along Decker's Creek.

H. tracheliifolius, Willd.
Mountain Woods. Fayette: near Nuttallburg, uncommon—L. W. N.

H. decapetalus, L.
Rich open woods. Monongalia: near Little Falls and Uffington. Fayette: near Nuttallburg, the most common species here; petals mostly 8—L. W. N.

VERBESINA, L.

V. occidentalis, Walt. Crownbeard.
Rich soil. Fayette: near Nuttallburg—L. W. N.; and along the Great Kanawha River to its mouth. Jackson: up 8-Mile Creek. Wood: near Lockhart's Run. Monongalia: near Morgantown. Summers: near Hinton. Jefferson: near Shepherdstown. Berkeley: near Martinsburg.

RIDANIA, Adans. (1763)
(Actinomeris, Nutt. 1818)

R. alternifolia, (L.), OK. (*Actinomeris squarrosa*, Nutt.)
Rich soil. Ohio: near Wheeling—M. & G. Fayette: near Nuttallburg, common—L. W. N. Monongalia: near Morgantown. Kanawha: near Charleston.

COREOPSIS, L.

C. lanceolata, L., *Var.* **villosa**, Michx.
Rich soil. Fayette: banks of New River near Nuttallburg—L. W. N.

C. pubescens, Ell
Rich shady place. Fayette: near Nuttallburg—L. W. N.

C. trichosperma, Michx.
Fields. Kanawha: near Charleston. Monongalia: near Morgantown.

C. auriculata, L.
Rich banks. Fayette: near Nuttallburg—L. W. N.; near Hawk's Nest—Porter. Monroe: near Alderson.

C. senifolia, Michx.
Shady woods. Greenbrier: near White Sulphur Springs—M. & G.

Var. **stellata**, Torr. & Gray.
Fayette: banks of New River near Nuttallburg—L. W. N.

C. tripteris, L. Tall Coreopsis.
Rich ground. Jackson: plentiful along 8-Mile Creek and on Limestone Ridge. Fayette: near Nuttallburg—L. W. N. Monongalia: near Little Falls.

BIDENS, L.

B. frondosa, L. Beggar's Ticks. Stick-tight. "Pitch-forks."
L. W. N., M. & G.
Damp waste places. Common throughout the State.

B. connata, Muhl. Swamp Beggar's Tick. M. & G.
Wet places. Frequent throughout the State.

Var. **comosa,** Gray.
Damp open places. Fayette: near Nuttallburg—L. W. N. Monongalia: near Morgantown and frequent throughout the State.

B. lævis (L.), B. S. P. *B. chrysanthemoides*, Michx. G., L. W. N., M. & G.
Wet places. Frequent throughout the State.

B. bipinnata, L. Spanish Needles. L. W. N., M. & G.
Dry places. Abundant throughout the State.

GALINSOGA, Ruiz & Pav.

G. PARVIFLORA, Cav.
Waste grounds. Mason: near Point Pleasant. Wood: near Parkersburg.

HELENIUM, L.

H. autumnale, L. Sneeze-weed.
Alluvial river banks. Wirt: along the Little Kanawha River. Fayette: near Nuttallburg—L. W. N. Monongalia: near Morgantown. Randolph: near Cheat Bridge, alt. 3660 ft. Summers: near Hinton. Hardy: near Moorefield—G.

ANTHEMIS, L.

A COTULA, L. Dogs Fennel. May-weed. L. W. N., M. & G.
Fields and waste grounds. Common throughout the State.

A. ARVENSIS, L. Chamomile.
Waste places. Morgan: along the B. & O. R. R. near No. 12 Water Tank.

ACHILLEA, L.

A. Millefolium, L. Yarrow. Milfoil. G., L. W. N., M. & G.
Common throughout the State, even in the most inaccessible portions of the virgin forests in the Alleghanies, where it certainly appears native. Randolph: Point Mountain, alt. 3300 ft. Nicholas: Buffalo Range, alt. 2875 ft.

CHRYSANTHEMUM, L.

C. Leucanthemum, L. Ox-Daisy. "Sheriff Pink." M. &. G.
Becoming too plentiful as a weed in fields, in the following counties: Monongalia, Marion, Hampshire: where it is often known as Sheriff Pink; Jackson, Preston, Kanawha: near Charleston—James; Cabell: near Barboursville—James (1877); Grant, Lewis, Upshur, Randoloph, Berkeley: near Martinsburg; Fayette: near Nuttallburg—L. W. N. Greenbrier: near Ronceverte, Caldwell, Fort Spring, and White Sulphur Springs. Hardy: near Moorefield—G. Mercer: near Princeton and Ingleside.

MATRICARIA, L.

M. DISCOIDEA, DC. Wild Chamomile.
Established on B. & O., R. R. bank, Morgan: near No. 12 Water Tank.

TANACETUM, L.

T. VULGARE, L. Tansy. M. & G.
Escaped to roadsides. Gilmer: near DeKalb. Lewis: near Weston. Grant: near Davis. Wood: near Parkersburg. Jefferson: near Shepherdstown. Monongalia: on Kingwood Pike.

SENECIO, L.

S. VULGARIS, L. Groundsel.
Roadsides, fence rows, streets, and waste places; adventive from Europe. Frequent.

S. aureus, L. Golden Rag-wort. L. W. N., V. M., M. & G.
Damp places in open woods. Frequent throughout the State.

Var. **obovatus** (Muhl.), T. & G.
Damp places. Lewis: near Weston. Monongalia: near Morgantown.

Var. **Balsamitæ** (Muhl.), T. & G.
Rocky open woods. Fayette: near Nuttallburg—L. W. N. Monongalia: near Morgantown. Mercer: near Beaver Spr.

CACALIA, L.

C. **suaveolens**, L. Indian Plantain.
Rich banks. Monongalia and Marion: from Opekiska to Morgantown along the Monongahela River, frequent. Preston: near Terra Alta. Summers: near Hinton. Ohio: near Wheeling—M. & G.

C. **reniformis**, Muhl. Great Indian Plantain.
Rich woods. Marion: along the F. M. & P., R. R., especially near Opekiska. Summers: near Greenbrier Stock Yards. Monroe: near Alderson and Wolf Creek. Preston: near Terra Alta. Ohio: Bogg's Island., near Wheeling—M. & G.

C. **atriplicifolia**, L. Pale Indian Plantain.
Rich woodlands. Upshur: near Lorentz. Monongalia: banks of Cheat of Cheat River, near Camp Eden. Ohio: near Wheeling—M. & G. Fayette: near Nuttallburg —L. W. N.

ERECHTITES, Raf.

E. **hieracifolia** (L.), Raf. Fireweed.
Moist woods and banks, especially new fallows. Randolph: near Cheat Bridge, alt. 3700 ft. Fayette: near Nuttallburg—L. W. N. Monongalia: near Uffington and Morgantown.

ARCTIUM, L.

A. **LAPPA**, L. Burdock. L. W. N., M. & G.
Waste grounds, near dwellings. Abundant everywhere.

Var. **MINUS**. Gray.
Fayette: near Nuttallburg—L. W. N.

CNICUS, L.

C. **LANCEOLATUS** (L.), Willd. Common Thistle. L. W. N., M. & G.
Fields, waste grounds, and roadsides. Common.

C. altissimus, (L.), Willd. Tall Thistle.

Fields and moist copses, frequent. Monongalia, Marion and Preston counties. Fayette: near Nuttallburg—L. W. N. Summers: near Greenbrier Stock Yards. Hardy: near Moorefield.

Var. **discolor**, Gray. M. & G.

Fields. Jefferson: near Charlestown; Summit Point; and near Shepherdstown.

C. Virginianus, (Michx.), Pursh. Virginia Thistle.

Woods and opens. Summers: near Hinton. Preston: near Terra Alta. Frequent throughout the State.

C. muticus, (Michx.), Pursh. Swamp Thistle. M. & G.

Wet places. Randolph: near Cheat Bridge, alt. 3700 ft. Upshur: near Lorentz. Kanawha: near Charleston. Preston: near Terra Alta.

C. odoratus, (Muhl.). B. S. P. Pasture Thistle. *Cirsium pumilum*, Spr.

Dry fields. Greenbrier: near White Sulphur Springs. Preston: near Terra Alta; near Cranberry Summit—M. & G.

C. ARVENSIS (L.). Hoffm. Canada Thistle. M. & G.

Dry fields, becoming troublesome in many localities. Jefferson: plentiful near Charlestown, where it was doubtless brought in baled hay by the Federal troops during the war. Randolph: on the apex of Point Mountain, alt. 3700 ft., in a field owned and cultivated two years ago by a Connecticut gentleman, who probably brought the seed there from the east. Greenbrier: near White Sulphur Springs. Jefferson: near Summit Point; and Shenandoah Junction. Hancock: near Holliday's Cove. Brooke: at Wellsburg.

Reported also from: Hampshire: near Slanesville; and Capon Bridge. Brooke: near Wellsburg. Ohio: near Beech Glen School House. Summers: near Jumping Branch. Putnam: near Hurricane, Paradise and Confidence. Jefferson: near Summit Point, Middleway, Mohler's, Shenandoah Junction, Leetown, and Charlestown. Lewis: near Camden. Harrison: near Shinnston, and Wallace. Mineral: near Patterson's Depot (since destroyed). Berkeley: near Martinsburg, and Gerrardstown. Wirt: near Burning Springs. Wetzel: near Endicott. Jackson: near Sandy, and Silverton. Kanawha: near Pocotaligo, and Gazil. Mercer: near Concord Church. Wayne: near Stone Coal. Braxton: near Bulltown, and Tate Creek. Tyler: in Mead dist. Roane: near Newton, and Looneyville. Upshur: near Evergreen. Wood: near Murphy's Mills, Volcano, Parkersburg, and Rockport. Ritchie: near Berea. Fayette: near Mountain

Cove. Marshall: near Meighen. Hardy: near Wardensville. Preston: near Independence, 1889-91. Monroe: near Union. Greenbrier: near Trout Valley, and Lewisburg. Grant: near Greenland. Hancock: near Holliday's Cove. Taylor: near Grafton. Cabell: near Milton. Clay: near Valley Fork. Doddridge: near Leopold.

The presence of this weed in the localities noted in the second paragraph, where not corroborated in the first, is open to doubt.

ADOPOGON, Neck. (1790).
(Krigia, Schreb. 1791.)

A. Dandelion (DC.). Dwarf Dandelion.
Kanawha: near Charleston, (?)—James.

A. amplexicaulis. (Michx.)
Moist woods and opens. Monongalia: near Morgantown. Wood: near Lockhart's Run, becoming a bad weed—Hopkins.

CICHORIUM, L.

C. Intybus, L. Chicory.
Fields. Jefferson: two stations near Shepherdstown. Greenbrier: near White Sulphur Springs—M. & G.

HIERACIUM, L.

H. Canadense. Michx. Hawkweed.
Dry Woods. Webster: near Upper Glade.

H. paniculatum, L.
Moist grounds. Preston: near Cranberry Summit—M. & G. Fayette: near Nuttallburg—L. W. N.

H. venosum. L. Rattlesnake-weed. G., L. W. N., M. & G.
Openings, and edges of dry woods. Frequent throughout the State

H. scabrum. Michx.
Dry open woods. Fayette: near Nuttallburg—L. W. N. Monongalia: along Decker's Creek. Preston: near Terra Alta.

H. Gronovii, L.
Dry soils. Fayette: near Nuttallburg, alt. 2000 ft. —L. W. N. Upshur, summit on Staunton Pike.

H. longipilum, Torr.
Dry situations. Monongalia: Decker's Creek, near Morgantown. Fayette: near Kanawha Falls, and Hawk's Nest—James.

PRENATHES, L.

P. altissima, L.
Rich moist woods. Fayette: near Nuttallburg—L. W. N.

P. alba, L.
Open woods. Hardy: near Moorefield—G.

P. serpentaria, Pursh. Gall-of-the-Earth.
Sandy woods. Randolph: near Cheat Bridge, alt. 3550 ft. Summers: near Hinton. Marion: near Catawba.

TARAXACUM, Haller.

T. OFFICINALE, Web. Dandelion. (*T. Dens-leonis*, Desf.) L. W. N., G.
All situations. Frequent throughout the State.

CHONDRILLA, Tourn.

C. JUNCEA, L. "Naked-weed." "Skeleton-weed."
Fields and roadsides. Hampshire: near Bloomery, where the name Naked-weed has been given it on account of the minutness of the leaves. Jefferson: near Summit, where it is called Skeleton-weed, for the same reason; near Charlestown. Berkeley: near Martinsburgh.

LACTUCA L.

L. SCARIOLA, L. Prickly Lettuce.
Fields. Monongalia: near Laurel Point, where it has become a troublesome weed.

L Canadensis, L. Wild Lettuce. Horse-weed. "Devil-weed." L. W. N., M. & G.
Meadows and fence-rows. Common throughout the State.

L. integrifolia, Bigel. "Devil's Iron-weed."
Fields and roadsides. Monongalia: near Morgantown. Mason: near Point Pleasant. Fayette: near Nuttallburg—L. W. N. Jackson: near Douglas.

L. hirsuta,, Muhl.
Dry open mountain sides. Fayette: near Nuttallburg--L. W. N.

L. leucophæa, (Willd.), Gray. (*Mulgedium leucophæum*, DC.)
Low woodlands. Fayette: near Nuttallburg—L. W. N. Monroe: near Alderson.

L. villosa, Jacq. (*Mulgedium acuminatum*, DC.)
Borders. Fayette: near Nuttallburg—L. W. N. Monroe: near Alderson. Preston: near Terra Alta.

L. Floridana, (L.), Gaertn.
Open banks and borders of woods. Fayette: near Nuttallburg—L. W. N.

SONCHUS, L.

S. OLERACEUS, L. Sow-thistle.
Waste grounds. Ohio: near Wheeling—M. & G.

S ASPER, Vill. Spiny leaved Sow-thistle. M. & G.
Roadsides and wastes. Monongalia: near Morgantown. Narion: near Fairmont. Hampshire: near Slanesville. Wetzel: near Littleton. Lewis: near Vadis. Cabell: near Union Ridge. Mercer: near Concord Church. Fayette: near Nuttallburg L. W. N. Doddridge: near Smithton.

TRAGOPOGON, L.

T. PORRIFOLIUS, L. Salsify. Oyster-plant.
Waste grounds. Morgan: near No. 12 Water Tank.

CAMPANULACEÆ.

LOBELIA, L.

L. cardinalis, L. Cardinal Flower.
Low grounds, and low banks of streams. Nicholas: Collett's Glade. Gilmer: near Glenville—V. M., Prof. Brown. Randolph: near Cricard P. O. Greenbrier: near White Sulphur Springs. Summers: near Talcott, and Hinton. Kanawha: near Kanawha City. Mason: near Brighton. Frequent throughout the State. Hardy: near Moorefield—G.

L. syphilitica, L. Great Blue Lobelia. M. & G.
Low wet grounds. Randolph: near Elkins, and along the valley of Tygart's. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg. Greenbrier: near White Sulphur Springs. Monongalia: near Morgantown. Summers:

near Hinton. Jefferson: near Shepherdstown. Hardy: near Moorefield.—G.

forma **albiflora,** Britt.
With the species. Randolph: near Huttonsville, frequent.

L. puberula, Michx.
Low grounds. Fayette: near Nuttallburg—L. W. N. Monongalia: near Morgantown.

L. amœna, Michx. *var.* **glandulifera,** Gray.
Swampy spots. Fayette: near Nuttallburg, alt. 2000 ft., rare—L. W. N.

L. leptostachys, A. DC.
Sandy soil. Wood: near Leachtown. Summers: near Hinton.

L. spicata, Lam. M. & G.
Sandy hillsides. Monongalia: near Ice's Ferry, and above Camp Eden. Upshur: near Buckhannon.

Var. **parviflora,** Gray.
Wet places. Gilmer: near Glenville—V. M.

L. inflata, L. Indian Tobacco. Lobelia. L. W. N. ,V. M., M. & G.
Dry soils. Common throughout the State.

Var. **simplex** (Raf.),
Dry places. Randolph: near Cricard, P. O. Characters of the species, but simple stemmed.

Having noted that this form perpetuated itself at one station in New York State, near Binghamton, for five years; I have decided that it is a true variety. Approaching the question from another point of view: I worked over a field near Morgantown this season, examining 783 small plants of L. inflata, many of which were not over four inches high, without finding a single simple-stemmed plant among them. At the station above named, as well as that in New York, there was a goodly amount of the variety, with none of the species in the immediate neighborhood.

SPECULARIA, Heist.

S. perfoliata, (L.), A. DC Venus' Looking-glass. M. & G.
Dry soils. Monongalia: near Morgantown. Upshur. near Buckhannon. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg—L. W. N. Hardy: near Moorefield —G.

CAMPANULA, L.

C. rotundifolia, L. Harebell. M. & G.
Moist rocks. Mineral: along the Potomac, near Keyser—W. Gilmer: near Glenville—V. M. Tucker: along the Blackwater.

C. aparinoides, Pursh. Marsh Bellflower.
Wet meadows. Preston: near Terra Alta.

C. Americana, L. Tall Bellflower. M. & G.
Rich woods, or even on dry rocks. Monongalia: near Ice's Ferry. Wood, Wirt and Calhoun counties, general. Gilmer: near Glenville—V. M., Prof. Brown. Lewis, and Upshur. Randolph: near Cheat Bridge, alt. 3650 ft., with wands 4-6 ft. high. Webster: in the glade region. Fayette: near Nuttallburg—L. W. N.; along Loup Creek—James. Kanawha and Jackson: general. Greenbrier: near White Sulphur Springs. Summers: near Hinton. Marion: near Worthington, and near Fairmont.

C. divaricata, Michx. M. & G.
Dry banks. Summers: near Talcott. Greenbrier: near White Sulphur Springs.

VACCINIACEÆ.

GAYLUSSACIA, H. B. K.

G. dumosa (Andr.), T. & G. Dwarf Huckleberry.
Damp, sandy soils. Kanawha: near Charleston—James. Hardy: near Moorefield.

G. frondosa (L.), T. & G. Dangleberry.
Low copses. Fayette: near Hawk's Nest—James. Webster: Upper Glade.

G. resinosa (Ait.), T. & G. Huckleberry.
Wirt: near Burning Springs. Monongalia: near Laurel Hills. Marion: near Forksburg. Fayette: near Nuttallburg—L. W. N. Frequent throughout the State.

OXYCOCCUS, Pers.

O. macrocarpus, Pers. Cranberry. (*Vaccinium macrocarpon,* Ait.) M. & G.
Glades. Webster: Welsh, Long and Upper Glades. (This station will be lost in a few years, as drainage is being practised here to reclaim the land). Preston: Glade Farms, Morgan's Glade, Cranberry, Reedsville and Terra Alta.

VACCINIUM, L.

V. stamineum, L. Deerberry.
Open woods. Wirt: near Burning Springs. Mineral: along Knobby Mts.—W. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg—L. W. N. Grant: near Bayard. Tucker: near Davis. Hardy: near Moorefield—G. Mercer: near Bluefield.

V. Pennsylvanicum, Lam. Dwarf Blueberry.
Dry hills. Gilmer: near Glenville—V. M. Brooke: near Wellsburg—M. & G.

V. vacillans, Soland. Low Blueberry.
Opens. Brooke: near Wellsburg—M. & G. Fayette: near Nuttallburg, alt. 2000 ft.—L. W. N.

V. corymbosum, L. Swamp Blueberry. "Seedy Deerberry."
Swampy thickets. Preston: Kingwood Glades; Terra Alta Glades. Webster: Welsh, Upper and Long Glades.

Var. **pallidum**, (Ait.), Gray.
Glady regions. Webster: in Upper Glade.

V. erythrocarpon, Michx.
Pocahontas: summit Spruce Knob, alt. 4800 ft.—A. D. Hopkins.

CHIOGENES, Salisb.

C. hispidula (L.), T. & G. Creeping Snowberry.
Tucker: On rocks in the mist of Blackwater Fall.

ERICACEÆ.

GAULTHERIA, Kalm.

G. procumbens, L. Wintergreen. Tea-berry. Mountain Tea. L. W. N.
Cool rich woods. Throughout the mountainous regions of the State.

EPIGÆA, L.

E. repens, L. Trailing Arbutus. M. & G.
In moss of shady woods. Monongalia, and Preston: along the Laurel Hills. Gilmer: near Glenville—V. M. Mineral: near Keyser—W. Kanawha: near Charleston—James. Fayette: near Nuttallburg—L. W. N. Hardy: near Moorefield—G. Mercer: near Bluefield.

ANDROMEDA, L.

A. ligustrina, Muhl. "Seedy Buckberry." M. & G.
Wet grounds. Preston: Morgan's Glade and Terra Alta. Upshur: near Buckhannon. Webster: Upper, Long and Welch Glades. Nicholas: Collett's Glade. Fayette: near Nuttallburg—L. W. N.

Var. **pubescens,** Gray.
Swampy place. Fayette: near Nuttallburg, alt. 2000 feet: a variation with a six-lobed corolla and six-celled ovary —L. W. N.

A. Mariana, L. Stagger Bush.
Low grounds, Webster: Long Glade. Summers: near Hinton.

OXYDENDRUM, DC.

O. arboreum, DC. Sour Gum. M. & G.
Rich woods. Wood: near Leachtown. Randolph: near Valley Bend. Gilmer: near Glenville—V. M. Kanawha: near Charleston—James. Fayette: ner Nuttallburg L. W. N. Summers: along Greenbrier River and near Hinton. Marion: near Shinnston and Clements. Monongalia: near Beechwoods. Mercer: Beaver Spr. and Ingleside.

KALMIA, L.

K. latifolia, L. Mountain Laurel. Calico-bush. Spoon-wood.
Dry or moist hillsides and thickets; forming impenetrable masses in the mountains. Calhoun: Laurel Run. Upshur: Sand Run. Webster: Buffalo Bull Mountains. Kanawha: near Charleston—Barnes. Nicholas: near Beaver Mills. Monongalia: near Ice's Ferry and Cheat View. Preston: Laurel Hills, thence southward throughout the eastern counties. Fayette: near Nuttallburg—L. W. N. Jefferson: near Harper's Ferry—M. & G.

K. angustifolia, L.. Sheep-laurel. Lamb-kill.
Hillsides. Calhoun: Laurel Run. Upshur: Sand Run. Nicholas: near Beaver Mills. Randolph: near Cheat Bridge. Hardy: near Moorefield.

MENZIESIA, Smith.

M. globularis, Salisb.
Pocahontas: summit of Spruce Knob, alt. 4800 ft. —A. D. Hopkins.

RHODODENDRON, L.

R. maximum, L. Great Laurel. James, L.W.N., V.M., M.&G.
Deep rich woods, forming the most dense and tangled thickets in the mountains. Western limit on the Great Kanawha River near Charleston, Kanawha County. Common throughout the eastern and northern portions of the State.

R. arborescens, Torr. Smooth Azalea.
Glades and along mountain streams. Fayette: near Nuttallburg—L. W. N. Webster: Upper and Welch Glades,

R. canescens (Michx.), Porter. Hoary Azalea.
Hampshire: Mutton Run, near Cacapon Springs; Dillon's Run, near Cacapon River.
Specimens in full leaf were noted at these points that differ widely from R. nudiflorum and R. calendulaceum, and seem, so far at least, to be this species.

R. viscosum (L.), Torr. M. & G.
Glades and cool ravines. Preston: Kingwood glades. Kanawha: near Charleston—Barnes. Fayette: near Nuttallburg—L. W. N.; near Hawk's nest—James. Webster: near Long Glade.

Var. **glaucum** (Lam.), Gray. "Cinnamon Honeysuckle."
Rocky streams in the higher mountains. Tucker: along the Blackwater Fork of Cheat.

Var. **nitidum** (Pursh,), Gray.
Glades. Webster: in Long and Upper Glades.

R. nudiflorum (L.), Torr. "Wild Honeysuckle." Pinxter Flower.
V. M., M. & G., W., L. W. N.,
Rocky places along streams. Common throughout the northern, central, and eastern portions of the State. Mercer: near Princeton 6-8 ft. high.

R. calendulaceum (Michx.), Torr. Flaming Azalea.
Mountain woods. Monongalia: Cheat View. Mineral: near Keyser—W. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg, alt. 1800 ft., flowers with a delicate fragrance quite distinct from that of other Azaleas—L. W. N. Summers: near Hinton. Preston: along the Laurel Hills. McDowell: near Elkhorn. Mercer: near Princeton and Bluefield.

R. Catawbiense, Michx. Lilac-colored Laurel.
Deep rich mountain woods, rare. Pendleton: near Cherry Grove. Fayette: near Nuttallburg, where it prefers

the face of cliffs—L. W. N. Greenbrier: Top of Alleghanies. Summers: near Hinton.

CLETHRA, L.

C. acuminata, Michx. White Alder.

Wooded banks. Fayette: along the Gauley River at the base of the Gauley Mountains: near Nuttallburg, uncommon—L. W. N.

PSEVA, Raf. (1809)
(Chimaphila, Pursh 1814.)

P. umbellata (L.), Prince's Pine.

Dry woods, rare compared with the next. Monongalia: along Decker's Creek: and on Laurel Hills in pine thickets.

P. maculata (L.), "Pipsisseway." M. & G.

Rich woods, frequent throughout the northern, eastern, and central counties. Gilmer: near Glenville—V. M. Prof. Brown. Kanawha: near Charleston—James. Fayette: near Hawk's Nest, and Kanawha Falls; near Nuttallburg—L. W. N. Hardy: near Moorefield—G.

MONESES, Salisb.

M. grandiflora, Salisb. One-flowered Pyrola.

Deep, cold woods. Gilmer: near Glenville—V. M. Preston: along Laurel Hills. Monongalia: near Cheat View, and along Quarry Run.

PYROLA, L.

P. elliptica, Nutt. Shin-leaf. M. & G.

Rich woods. Kanawha: near Charleston—James. Preston: near Terra Alta.

P. rotundifolia, L. Shinleaf. M. & G.

Sandy woodlands, frequent. Upshur: summit on Staunton Pike. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg—L. W. N. Grant: near Bayard. Hardy: near Moorefield—G.

MONOTROPEÆ.

MONOTROPA, L.

M. uniflora, L. Indian-pipe. Corpse-plant. M. & G.

Deep, rich woods. Wirt: near Elizabeth. Kanawha: near Charleston—James. Gilmer: near Glenville—V. M.

Fayette: near Nuttallburg—L. W. N. Preston: near Terra Alta. Grant: near Bayard. Hardy: near Moorefield—G.

HYPOPITYS, L.

H. Monotropa, Crantz. Pine Sap. (*Monotropa Hypopitys, L.*)
Deep, rich woods. Wirt: near Elizabeth. Fayette: near Nuttallburg—L. W. N. Gilmer: near Glenville—V. M., Prof. Brown. Kanawha: near Charleston—James. Upshur: Summit on Staunton Pike.

DIAPENSIACEÆ.

GALAX, L.

G. aphylla, L.
Woodlands. Fayette: near Nuttallburg—L. W. N. Monongalia: Dille Farm near Morgantown.

PRIMULACEÆ.

DODECATHEON L.

D. Meadia, L. Shooting Star.
Rich woods. Mineral: near Keyser—W. Hardy: near Moorefield—G.

TRIENTALIS, L.

T. Americana (Pers.), Pursh. Star Flower.
Damp cool woods. Mineral: near Piedmont. Grant: near Bayard. Tucker: along Blackwater Fork of Cheat. Preston: near Terra Alta. Monongalia: near Laurel Point.

STEIRONEMA, Raf.

S. ciliatum (L.), Raf. M. & G.
Low grounds and ditches. Randolph: on Rich Mountain, alt. 1610–2125 ft.; on Point Mountain. Grant: near Bayard. Gilmer: near Glenville—Prof. Brown. Fayette: near Nuttallburg—L. W. N.; near Hawk's Nest. Tucker: near Davis.

S. lanceolatum (Walt.). Gray.
Low grounds. Wood: near Kanawha Station. Lewis: along Stone Coal Creek. Randolph: along Tygart's Valley River. Monongalia: Camp Eden.

Var. **angustifolium** (Lam.) Gray.
Low grounds. Monongalia: Sandy banks of Cheat River above Camp Eden.

LYSIMACHIA L.

L. quadrifolia, L. Loosestrife. L. W. N., V. M., M. & G.
Moist soils. In all sections of the State visited.

L. terrestris (L.), B. S. P. (*L. stricta*, Ait.)
Wet places. Fayette: near Nuttallburg, in railroad ditches, infrequent—L. W. N. Ohio: on Bogg's Island—M. & G. Wood near Kanawha Station.

L. MUMMULARIA, L. Money-wort.
Escaped from cultivation. Wood: near Lockhart's Run, profuse.

L. thyrsiflora, L. Pyramidal Loosestrife.
Wet meadows near the mountains. Upshur: near Buckhannon. Randolph: along Tygart's Valley River. Morgan: near Hancock.

ANAGALLIS, L.

A. ARVENSIS, L. Poor Man's Weather-glass.
Waste places. Jefferson: near Bolivar Heights—M. & G.

SAMOLUS, L.

S. VALERANDI, *var.* **floribundus**, (H. B. K.), B.S.P.
var. Americanus, Gray.
Sandy places. Summers: shores of New River near Hinton.

EBENACEÆ.

DIOSPYROS, L.

D. Virginiana, L. Persimmon. Date Plum. M. & G.
Thickets and opens. Wood: throughout. Fayette: near Nuttallburg—L. W. N. Gilmer: near Glenville—V. M. Monongalia: near Morgantown. Wirt: along Little Kanawha River. Jackson: near Ripley. Lewis: along Leading Creek.

STYRACACEÆ.

HALESIA, Ellis.

H. tetraptera, L. "Shittimwood."
Banks of streams. Fayette: near Nuttallburg—L. W. N.; below Gauley Bridge. Summers: near Hinton, abundant.

OLEACEÆ.

FRAXINUS, L.

F. Americana, L. White Ash. L. W. N., M. & G.
Rich woods. Frequent throughout the State.

F. pubescens, Lam. Red or Black Ash.
Low grounds. Randolph: along Tygart's Valley River. Upshur: near Lawrence. Fayette: near Nuttallburg—L. W. N. Wood: along the Little Kanawha River. Mason: near Point Pleasant.

F. viridis, Michx. f. Green Ash.
Along streams. Summers: near Hinton. Frequent throughout the State.

F. sambucifolia, Lam. Black Ash.
Wet woods. Wirt: along Straight Creek. Fayette: near Nuttallburg, rare—L. W. N. Randolph: on Point Mountain. Webster: Buffalo Bull Mountain. Monongalia: near Ice's Ferry. Summers: Hinton.

CHIONANTHUS, L.

C. Virginica, L. Fringe Tree.
River banks. Jackson: near Sandy and Ripley. Fayette: near Nuttallburg, plentiful—L. W. N.; along Gauley River near Gauley Mountains. Summers: near Hinton. Monongalia: along Tibb's Run.

LIGUSTRUM, L.

L. VULGARE, L. Privet.
Escaped from cultivation to waste places. Kanawha: near Charleston—Barnes.

APOCYNACEÆ.

APOCYNUM, L.

A. androsæmifolium, L. Spreading Dog's-bane. M. & G.
Meadows, fields, and borders of thickets. Randolph: near Cricard P. O.; near Valley Head. Greenbrier: near White Sulphur Springs. Mason: near Point Pleasant; near Brighton; near Buffalo.

A. cannabinum, L. "Rheumatism weed." Indian Hemp. "Wild Cotton." M. & G.
Moist grounds, fields, and banks of streams. Frequent or common throughout the State.

Var. **pubescens** (R. Br.), DC.
Hardy: near Moorefield—G.

ASCLEPIAS, L.

A. tuberosa, L. Pleurisy-root. M. & G.
Fields and meadows. Wood: near Leachtown. Monongalia: near Morgantown and at Camp Eden. Lewis: along Leading and Stone Coal Creeks. Webster: near Long Glade. Fayette: near Nuttallburg—L. W. N.; near Kanawha Falls—James; near Gauley Bridge. Jackson: near Fisher's Point. Gilmer: near Glenville—V. M.; Prof. Brown. Doddridge: near Smithton. Jefferson: near Shenandoah Jc. Berkeley: near Martinsburg. Hardy: near Moorefield—G.

A. rubra, L.
Damp woods. McDowell: near Elkhorn.

A. purpurascens, L. Purple Milk-weed.
Damp grounds. Fayette: near Nuttallburg—L. W. N.; near Quinnimont. Hardy: near Moorefield—G.

A variegata, L.
Dry Woods. Wirt: near Elizabeth. Upshur: near School House Summit. Hardy: near Moorefield—G. Fayette: near Nuttallburg—L. W. N.

A. incarnata, L. Swamp Milk-weed. M. & G.
Wet places. Wirt: near Burning Springs. Gilmer: along Tanner's Fork. Randolph: along Tygart's Valley River, alt. 1963–2200 ft. Fayette: near Nuttallburg—L. W. N. Monongalia: near Stewartown. Summers: near Hinton. Kanawha: near Charleston. Marion: near Worthington.

Var. **pulchra** (Ehrh.), Pers.
Hardy: near Moorefield—G.

A. Syriaca, L. Milk-weed. *A. Cornuti*, Dec. G., V. M., M. & G.
Fields and roadsides. Common throughout the State, even in the wildest portions.

A. exaltata (L.), Muhl, Poke Milk-weed. *A. phytolaccoides*, Pursh. M. & G.
Moist copses. Randolph: near Valley Bend; on Point Mountain, alt. 1963–3300 ft. Preston: near Terra Alta. Grant: near Bayard. Tucker: near Davis. Fayette: near Nuttallburg—L. W. N.

A. quadrifolia, L. Four-leaved Milk-weed. M. & G.
Open woodlands. Mineral: near Keyser—W. Kanawha: near Charleston—Barnes. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg—L. W. N. Monongalia: near Maple Run—M. H. Brown. Summers: near Hinton. Hardy: near Moorefield—G.

ACERATES, Ell.

A. viridiflora (Raf.), Ell. Green-flowered Milk-weed.
Berkeley: near Martinsburg—M. & G. Mineral: near Keyser. Jefferson: near Charlestown. Jackson: along Limestone Ridge.

GONOLOBUS, Michx.

G. lævis, Michx.
Climbing over weeds and fences. Mason: near Point Pleasant. Putnam: near Buffalo.

LOGANIACEÆ.

MITREOLA, L.

M. petiolata, Torr. & Gray.
Damp soil. Fayette: near Nuttallburg; rare—L. W. N.

GENTIANEÆ.

SABBATIA, Adans.

S. angularis (L.), Pursh. Centaury.
Rich soil. Jackson and Wood counties, frequent. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg—L. W. N. Monongalia: near Easton. Summers: near Hinton. Harrison: near Lumberport. Marion: near Clements.

GENTIANA, L.

G. quinquefolia, L. Four-leaved Gentian. (*G. quinqueflora*, Lam.)
Opens. Doddridge: near Long Run. Hardy: near Moorefield—G.

G. Andrewsii, Griseb. Andrew's Gentian.
Moist woods. Fayette: near Nuttallburg, alt. 2000 ft.—L. W. N.. Monongalia: near Cheat View. Preston: near Reedsville.

G. Saponaria, L. Soapwort. Gentian.
Moist woods. Fayette: near Kanawha Falls—Selby.

G. linearis, Froel.
Boggy places. Preston: near Terra Alta and Morgan's Glade.

OBOLARIA, L.

O. Virginica, L. Pennywort.
Moist woods. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg—L. W. N. McDowell: near Elkhorn.

POLEMONIACEÆ.

PHLOX, L.

P. paniculata, *Var.* **acuminata** (Pursh.), Chapm.
Monroe: banks of Greenbrier river--L, W. N.

P. maculata, L. Wild Sweet William.
Grassy woodlands along streams. Wirt: above Burning Springs, plentiful. Upshur: near Lorentz. Randolph: along Tygart's Valley River from Beverly to Valley Head. Hardy: near Moorefield—G.

P. amœna, Sims.
Dry open woods. Fayette: near Nuttallburg, frequent—L. W. N.

P. reptans, Michx.
Deep damp woods. Gilmer: near Glenville—V. M. Grant: near Bayard. Tucker: near Davis. Fayette: near Nuttallburg—L. W. N. Mercer: near Bluefield.

P. divaricata, L. M. & G.
Rocky woods. Monongalia: near Morgantown and Stumptown. Gilmer: near Glenville—V. M., Prof. Brown. Hardy: near Moorefield—G. Fayette: near Nuttallburg--L. W. N. Mercer: near Bluefield.

P. sublata, L. Moss Pink.
Dry rocky places. Mineral: near Keyser—W. Fayette: near Hawk's Nest—James. Monongalia and Marion: near the F. M. & P. R. R. Hardy: near Moorefield—G. Mercer: near Bluefield.

POLEMONIUM, L.

P. reptans, L. Greek Valerian. M. & G.

Damp woods. Monongalia: in Brand's Woods near Easton, where it is used by the people of that neighborhood as a stomachic and tonic. Rich woods, near Morgantown. Gilmer: near Glenville.—V. M.

P. cæruleum, L. Jacob's Ladder.

Moist opens. Preston: near Cranberry Summit.—M. & G.

HYDROPHYLLACEÆ.

HYDROPHYLLUM, L.

H. macrophyllum, Nutt. Small-leaved Water-leaf.

Rich woods. Gilmer: near Glenville.—V. M. Wetzel: near Burton.—M. & G.

H. Virginicum, L. Water-leaf.

Rich woods. Monongalia and Marion: along the Monongahela river. Ohio: near Wheeling.—M. & G. Hampshire: near Romney.

H. Canadense, L. Canadian Water-leaf.

Damp rich woods. Monongalia and Marion: along the Monongahela River. Fayette: near Kanawha Falls—James. Ohio: near Wheeling.—M. & G.

H. appendiculatum, Michx.

Ohio: Thomas' Hill, near Wheeling.—M. & G. Mineral: near Keyser—W. Grant: near Bayard. Tucker: near the Falls of Blackwater.

PHACELIA, Juss.

P. bipinnatifida, Michx.

Rich soil. Fayette: near Nuttallburg, on or among damp mossy rocks.—L. W. N.

P. Purshii, Buckley.

Moist wooded banks. Monongalia: banks of Decker's Creek. Mineral: near Keyser.—W. Gilmer: near Glenville.—V. M.

P. parviflora, Pursh.

Shaded banks. Fayette: near Nuttallburg—L. W. N.

ASPERIFOLIÆ.

CYNOGLOSSUM, L.

C. OFFICINALE, L. Hound's Tongue. "Dog-burr." M. & G.
Waste places and roadsides. Jefferson: near Shenandoah Jc. Gilmer: near Glenville—Prof. Brown. Hardy: near Moorefield—G. Mercer: generally frequent.

C. Virginicum, L. Wild Comfrey. M. & G.
Wood openings. Calhoun: near White Pine. Grant: near Bayard. Preston: near Terra Alta. Monongalia: near Morgantown Gilmer: near Glenville—V. M. Summers: near Hinton.

ECHINOSPERMUM, Sw.

E. Virginicum (L.), Lehm. Beggar's-lice. G., L. W. N., V. M., M. & G.
Borders and thickets. Frequent throughout the State.

MERTENSIA, Roth.

M. Virginica (L.), DC. Virginian Cowslip. Lung-wort. Blue-bells. M. & G.
Rich woods. Monongalia and Marion; along the Monongahela River. Lewis: along Stone Coal Creek. Wirt: near Elizabeth. Upshur: near Laurentz. Gilmer: near Glenville—V. M., Prof. Brown. Hardy: near Moorefield —G.

ONOSMODIUM, Michx.

O. Carolinianum, DC.
Summers: banks of New River near Hinton.

MYOSOTIS, L.

M. PALUSTRIS (L.), Relh. Forget-me-not.
Damp places. Jefferson: near Harper's Ferry—M. & G.

SYMPHYTUM, L.

S. OFFICINALE, L. Comfrey.
Waste places. Gilmer: near Glenville—V. M. Mercer: near Ingleside.

LITHOSPERMUM, L.

L. ARVENSE, L. Corn Cromwell.

Fields. Ohio: near Wheeling—M. & G. Fayette: near Nuttallburg—L. W. N.

L. latifolium, Michx. Stone-seed.

Ohio: Cowan's Hill near Wheeling—M. & G. Fayette: near Nuttallburg; rare, not found in 1891—L. W. N. Monongalia: near Little Falls—K. D. Walker.

L. canescens (Michx.), Lehm. Puccoon.

Open woods. Mineral: on Knobby Mountain—W. Hardy: near Old Fields—A .D. Hopkins; and Moorefield—G. Hampshire: near Romney.

ECHIUM, L.

E. VULGARE, L. "Blue Weed." "Blue Devils." "Blue Thistle." "Blue Stem." M. & G.

Fields and waste ground. Jefferson: abundant especially near Charlestown, where there are many fields absolutely blue with the plant. Dr. Gray says of his trip through this country: "From the moment we entered the valley, we observed such immense quantities of Echium vulgare, that we were no longer surprised at the doubt expressed by Pursh whether it were really an introduced plant;" near Shenandoah Junction; Shepherdstown and Harper's Ferry. Randolph: along Tygart's Valley River; near Huttonsville, and up Riffles Creek. Berkeley: near Martinsburg, plentiful. Morgan: near Hancock, Cacapon and Orleans X Roads. Mineral: near Keyser, and Piedmont. Fayette: near Kanawha Falls—James; near Nuttallburg—L. W. N. Kanawha: opposite Coalburg. Summers: near Hinton. Jefferson: near Summit Point. Greenbrier: near White Sulphur Springs. Hardy: near Moorefield.

Alsn reported from: Jefferson: near Ripon, Summit Point, Middleway and Kabletown. Berkeley: near Oakton and Hedgesville. Morgan: near Rock Gap. Hampshire: near Slanesville, Concord, Romney, Three Churches, Dillon's Run, Higginsville, Sedan, Purgitsville and Springfield. Mineral: near Blaine. Hardy: near Moorefield, Wardensville and Old Fields. Grant: near Medley, Greenland and Petersburg. Tucker: near Hendricks and St. Georges. Pendleton: near Franklin and Upper Tract. Pocahontas: near Lobelia. Greenbrier: near Williamsburg and Fort Spring. Summers: near Talcott. Mercer: near Princeton and New Hope. McDowell: near Squire Jim. Wood: near Waverly. Lewis: near Vadis and Aberdeen. Barbour: near Old Field. Webster: near Replete. Wetzel: near Endicott. Doddridge:

near Smithton. Marshall: near Lowdenville. Roane: near Clio and Walnut Grove. Kanawha: near Tornado. Taylor: near Thornton; and Clay: near Valley Fork,

CONVOLVULACEÆ.

IPOMŒA, L.

I. COCCINEA, L. Scarlet Morning-glory.

Waste grounds. Monongalia: near Morgantown. Mason: near Point Pleasant.

I. HEDERACEA, Jacq. Ivy-leaved Morning-glory.

Waste places. Mason: sandy banks of the Ohio near Point Pleasant. Fayette: near Nuttallburg, banks of New River—L. W. N. Berkeley: near Martinsburg. Hardy: near Moorefield—G.

I. PURPUREA (L.), Lam. Morning-glory.

Fields, cultivated grounds and waste places. Mineral: near Keyser—W. Fayette: near Nuttallburg—L. W. N. Wood: near Lockhart's Run. Monongalia: near Morgantown. Jackson: near Sandyville. Mason and Putnam: an abundant weed in corn fields.

I. PANDURATA (L.), Meyer. "Wild Sweet Potato." M. & G.

Fields, roadsides, and waste places. Monongalia: near Stewartown, Morgantown and Glenville. Marion: near Houghtown, Opekiska, and Fairmont. Wood: near Kanawha Station and Lockhart's Run. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg—L. W. N. Greenbrier: near White Sulphur Springs. Monroe: near Alderson. Mason: near Point Pleasant. Summers: near Hinton. Hardy: near Moorefield—G.

Reported as a troublesome weed, from the following localities: Marion: near Canton, Farmington, Barracksville, Eldora, and Worthington. Taylor: near Grafton. Harrison: near Clarksburg, Bridgeport, Good Hope, Mt. Clair, and Wallace. Hampshire: near Slanesville, Concord, Three Churches, Bloomery, Dillon's Run, and Springfield. Jefferson: near Summit Point, Shenandoah Jc., Middleway, and Kabletown. Jackson: near Douglass, Lone Cedar, Grass Lick, Garfield, Wilding, Odaville, Belgrove, and Kentuck. Ohio: near Alum Grove. Hancock: near New Cumberland. Lincoln: near Hamlin. Wood: near Waverly, Belleville, Tyner, Jerry's Run, Fountain Spring, Blennerhassett, Murphy's Mills, Deer Walk, and Rockport. Lewis: near Vadis, and Aberdeen. Wirt: near Burning Springs, Morris, Elizabeth, and Reedy Ripple. Summers: near Forest Hill, Talcott, Clayton, and Indian Mills. Preston: near Masontown,

and Reedsville. Wetzel: nerr Endicott, Pine Grove, New Martinsville, and Blake. Mineral: near Patterson's Depot, and Piedmont. Berkeley: near Oakton, Martinsburg, and Gerardstown. Webster: near Replete. Ritchie: near Ritchie C. H., and Highland. Mercer: near Princeton, Concord Church, Bramwell and New Hope. Cabell: near Union Ridge and Milton. Kanawha: near Pocotaligo, Blandon and Gazil. Monroe: near Cashmere, and Johnson's X Roads. Wayne: near Adkin's Mills, and Stone Coal. Randolph: near Florence. Doddridge: near Smithton, Center Point, and Leopold. Fayette: near Fayetteville. Braxton: near Bulltown, Lloydsville, Frametown, and Newville. Tyler: near Wick, and Long Reach. Roane: near Newton, Looneyville, Clio, Reedy, Walnut Grove and Peneil. Upshur: near Evergreen, Kanawha Head, and Overhill. Barbour: near Pepper. Marshall: near Meighen, and Welcome. Grant: near Medley, and Greenland. Raleigh: near Egeira, and Raleigh C. H. Greenbrier: near Traut Valley, and White Sulphur Springs. McDowell: near Squire Jim. Mason: near Maggie. Taylor: near Thornton, and Meadland. Brooke: near Wellsburg, and Fowler's. Pleasants: near Schultz. Putnam: near Carpenter's. Hardy: near Old Fields. Clay: near Valley Fork.

I. lacunosa, L.

Fayette: sandy banks of New River near Nuttallburg —L. W. N. Summers: near Hinton.

CONVOLVULUS, L.

C. spithamæus, L.

Rocky soil. Mineral: near Keyser—W.

C. sepium, L. Hedge Bindweed. M. & G.

Alluvial soils. Monongalia: near Little Falls; and along Decker's Creek. Mason: near Point Pleasant.

Var. **repens** (L.), Gray.

Rocky river banks. Fayette: banks of New River near Nuttallburg—L. W. N. Monongalia: below Morgantown.

CUSCUTA, L.

C. Trifolii, Weihe. Clover Dodder.

Parasitic on Clover. Greenbrier: near White Sulphur Springs.

C. Gronovii, Willd. Dodder. G., L. W. N., M. & G.

Parasitic on grasses, sedges, and low weeds. Frequent in wet places throughout the State.

C. glomerata, Choisy.
Parasitic on Compositae. Monongalia: near Little Falls.

SOLANACEÆ.

SOLANUM, L.

S. DULCAMARA, L. Bitter-sweet. W., M. & G.
Damp places. Frequent throughout the State, but not so much so as the next.

S. nigrum, L. Common Nightshade. G., L. W. N., V. M., M. & G.
Fields, roadsides, and cultivated grounds. Common throughout the State.

S. CAROLINENSE, L. Horse Nettle. "Radical Weed." M. & G.
Becoming a detestable weed in fields and forests. Calhoun: along Leading Creek. Wood: near Kanawha Station. Wirt: near Elizabeth. Randolph: near Cricard P. O. Webster: on Buffalo Bull Mountains. Nicholas: near Beaver Mills. Gilmer: near Glenville-V. M. Fayette: near Nuttallburgh-L. W. N. Monongalia: near Ice's Ferry. Cabell: near Barboursville. Greenbrier: near White Sulphur Springs. Monroe: near Alderson. Summers: near Hinton. Kanawha: near Charleston. Mason: near Point Pleasant. Jefferson: near Flowing Springs, and Shepherdstown. Mercer: near Ingleside.

Reported as a troublesome weed from: Harrison: near Clarksburgh, Wilsonburgh, Good Hope, Mt. Clair, and Wallace. Ohio: near Elm Grove and West Liberty. Wood: near Waverly, Belleville, Deer Walk and Kanawha Station. Hardy: near Moorefield and Wardensville. Grant: near Medley and Petersburg. Jefferson: near Moore's and Kabletown. Summers: near Forest Hill and Talcott. Wetzel: near Endicott, Pine Grove, New Martinsville and Blake. Mineral: near Patterson's Depot, and Blaine. Wirt: near Burning Springs, Morris, Evelyn, and Reedy Ripple. Jackson: near Grass Lick, and Odaville. Cabell: near Union Ridge, and Barboursville. Taylor: near Knottsville. Wayne: near Stone Coal, and Adkin's Mills. Doddridge: near Smithton, and Center point. Marshall: near Knoxville, and Welcome. Braxton: near Bulltown, and Tate Creek. Berkeley: near Hedgesville. Mercer: near Bramwell, and New Hope. Roane: near Looneyville, Clio, Reedy, and Peneil. Pocahontas: near Lobelia. Kanawha: near Blandon. Greenbrier: near Trout Creek. McDowell: near Squire Jim. Mason: near Maggie. Brooke: near Wellsburgh. Marion: near Mannington. Taylor: near Grafton. Upshur: near Kanawha Head, Overhill, and Hemlock. Hampshire: near

Higginsville and Springfield. Tyler: near Long Reach. Webster: near Welsh Glade. Clay: near Valley Fork.

PHYSALIS, L.

P. Philadelphica, Lam.
Rich opens. Fayette: near Nuttallburg—L. W. N.

P. angulata, L. Ground Cherry.
Open rich grounds. Grant: near Bayard. Gilmer: near Glenville—V. M. Wood: near Kanawha Station.

P. pubescens, L.
Low grounds. Fayette: near Nuttallburg—L. W. N. Ohio: near Wheeling—M. & G. Jefferson: near Shepherdstown. Mason: near Point Pleasant.

P. Virginiana, Mill.
Light sandy soils. Monongalia: near Beechwoods. Jefferson: near Shepherdstown. Jackson: near Ripley. Hardy: near Moorefield—G.

P. viscosa, L.
Low grounds. Ohio: near Wheeling—M. & G. Hardy: near Moorefield—G.

P. lanceolata, Michx.
Dry opens. Jackson: near Ripley. Wood: near Sharktown.

PHYSALODES, Bohn, (1760)
(Nicandra, Adans, 1763)

P. PHYSALOIDES (L.) Apple-of-Peru.
Waste grounds. Lewis: near Weston. Mineral: near Piedmont.

LYCIUM, L.

L. VULGARE (Ait), Dun. Matrimony Vine.
A frequent and persistent escape. Berkeley: near Martinsburgh. Jefferson: near Shepherdstown. Mason: banks of the Ohio near Point Pleasant.

DATURA, L.

D. STRAMONIUM L. "Jimson-weed." Jamestown-weed. Stink-weed. L. W. N., V. M., M. & G., G.
Waste places. A common weed throughout the State.

D. TATULA, L. Purple Thorn-apple. L. W. N., V. M., M. & G.
With the last. Common throughout the State.

PETUNIA, L.

P. VIOLACEA, Hook.
Escaped to waste grounds. Monongalia: near Morgantown, common, where it persists annually. Mason: near Point Pleasant. Jefferson: near Shepherdstown.

SCROPHULARINEÆ.

VERBASCUM, L.

V. THAPSUS, L. Mullein. L. W. N., V. M., M. & G.
Old fields and pastures. Common throughout the State.

V. BLATTARIA, L. Moth Mullein. M. & G.
Fields and waste places. Wirt: along the Little Kanawha River. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg—L. W. N. Monongalia and Marion, common. Grant: near Bayard. Jefferson: near Charlestown. Berkeley: near North Mountain. Elsewhere frequent.

V. LYCHNITIS, L. Yellow Moth-mullein.
Fields and wastes. Kanawha: roadside, up 8 Mile Creek. Mineral: opposite Cumberland, Md.

LINARIA, Juss.

L. VULGARIS, Mill. Toad Flax. "Devil's Flax." "Wild Flax." "Indian Hemp." "Impudent Lawyer." M. & G.
Fields, roadsides and waste places. Monongalia: near Stewarttown. Jefferson: near Charlestown and Shenandoah Junction. Jackson: near Sandyville. Berkeley: near North Mountain. Mineral: near Piedmont and Keyser. Hardy: near Moorefield—G.

Also reported as a weed from: Harrison: near Good Hope. Ohio: near West Liberty. Wood: near Jerry's Run, Fountain Spring, Blennerhassett, and Rockport. Jefferson: near Molers. Wetzel: near Endicott. Mineral: near Piedmont. Wirt: near Burning Spring, Morris and Reedy Ripple, Jackson: near Lone Cedar, Garfield, and Belgrove. Cabell: near Union Ridge. Taylor: near Thornton and Meadland. Wayne: near Stone Coal. Marshall: near St. Joseph. Berkeley: near Martinsburg. Greenbrier, near White Sulphur Springs. Mason: near Grimm's Landing and Maggie. Upshur: near Kanawha Head and Overhill. Tyler: near Long Reach. Webster: near Welch Glade.

Preston: near Tunnelton and Terra Alta. Hancock: near New Cumberland and Fairview. Ritchie: near Ritchie C. H. Monroe: near Pickaway. Morgan: near Rock Gap. Tucker: near Texas. Raleigh: near Raleigh C. H.

SCROPHULARIA, L.

S. nodosa, L., *var.* **Marilandica** (L.), Gray. Figwort. M. & G.
Fields and waste places. Monongala: near Morgantown. Fayette: near Nuttallburg—L. W. N. Greenbrier: near White Sulphur Springs. Kanawha: near Charleston.

COLLINSIA, Nutt.

C. verna, Nutt.
Moist soil. Gilmer: near Glenville—V. M.; Prof. Brown. Ohio: on Wheeling Hill—M. & G. Monongalia: near Cassville.

CHELONE, L.

C. glabra, L. Snake Head.
Wet places. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg, uncommon—L. W. N. Wirt: near Burning Spring.

C. obliqua, L.
Wet places. Randolph: along Cheat River near Cheat Bridge. Monongalia: ner Camp Eden.

PENTSTEMMON, Mitch.

P. hirsutus(L), Willd. Beard-tongue. (*P. pubescens*, Sol.)
Dry or rocky places Kanawha: near Charleston—Barnes. Gilmer: near Glenville—V. M. Cabell: near Barboursville—James. Hardy: near Moorefield—G. Hampshire: near Doe's Gully.

P. lævigatus, Soland.
Rich soil. Fayette: near Nuttallburg, in open woods—L. W. N.

Var. **Digitalis**(Nutt.) Gray.
Rich soil. Monongalia: along the Monongahela River, frequent. Wood: near Kanawha Station. Fayette: near Kanawha Falls—James. Hardy: near Moorefield. Hampshire: near Doe's Gully.

MIMULUS, L.

M. ringens, L. Monkey Flower. M. & G.
Wet places. Upshur: along Stone Coal Creek. Fayette: near Kanawha Falls—James; near Nuttallburg—L. W. N. Randolph: along Tygart's Valley River. Frequent: throughout the State.

M. alatus, Ait. Winged Monkey Flower.
Wet places. Greenbrier: near White Sulphur Springs. Putnam: near Buffalo.

GRATIOLA, L.

G. Virginiana, L. Gratiola. L. W. N., M. & G.
Ditches. Common throughout the State.

G. sphærocarpa, Ell.
Damp places. Fayette: near Nuttallburg, on mossy banks in bed of creek.—L. W N.

ILYSANTHES, Raf.

I. gratioloides(L), Benth. False Pimpernel. (*I. riparia*, Raf.)
Wet places. Fayette: near Kanawha Falls—James. Along Little Kanawha River—M. & G.

VERONICA, L.

V. Virginica, L. Culver's Physic.
Rich woods and borders. Webster: Long Glade. Jackson: near Sandyville. Fayette: near Nuttallburg.—L. W. N.

V. Anagallis, L. Water Speedwell.
Banks and ditches. Fayette: near Kanawha Falls—James.

V. Americana, Schw. American Brooklime. "Wallink." M. & G.
Brooks and ditches. Monongalia: the Flats near Morgantown. Randolph: on Point Mountain, alt. 3,050 ft. (where it is called "Wallink," and is used internally to bring out rashes.) Webster: near Addison, alt. 2,000 ft. Mercer: near Beaver Spr.

V. officinalis, L. Speedwell. "Gypsy Weed." M. & G.
Rich, deep woods and opens. Randolph: on Rich Mountains. Gilmer: near Glenville—V. M. Kanawha: near Charleston—James. Fayette: near Nuttallburg—L. W. N. Monongalia: along Decker's Creek. Greenbrier: near

White Sulphur Springs: and frequent throughout the State. Mercer: near Beaver Spr., and Bluefield.

V. serpyllifolia, L. Thyme-leaved Speedwell.
Roadsides, fields and lawns. Monongalia: near Morgantown. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg—L. W. N. Ohio: near Wheeling—M. & G. Mercer: near Bluefield.

V. peregrina, L. Neck Weed. Purslane-speedwell.
Waste places. Monongalia: near Morgantown. Fayette: near Nuttallburg—L. W. N. Ohio: Thomas Hill, near Wheeling—M. & G.

V. ARVENSIS, L. Corn Speedwell.
Cultivated grounds. Gilmer: near Glenville—V. M. Ohio: Thomas Hill, near Wheeling—M. & G. Fayette: near Nuttallburg—L. W. N.

BUCHNERA, L.

B. Americana, L. Blue Hearts.
Moist, sandy ground. Putnam: near Buffalo.

GERARDIA, L.

G. pedicularia, L.
Hardy: near Moorefield—G. Fayette: near Nuttallburg—L. W. N.

G. tenuifolia, Vahl. Slender Gerardia.
Dry soil. Mineral: near Keyser—W. Fayette: near Nuttallburg, alt. 2000 ft.—L. W. N. Randolph: near Elkins.

G. Virginica (L.). B.S.P. Oak-leaved Gerardia. *G. quercifolia*, Pursh.
Open woods. Fayette: near Nuttallburg—L. W. N.

G. flava, L. Flase Foxglove,
Open woods. Wood: near Leachtown. Fayette: near Kanawha Falls and Hawk's Nest—James; near Nuttallburg—L. W. N. Gilmer: near Glenville—V. M. Hardy: near Moorefield—G.

G. lævigata, Raf.
Oak woods. Fayette: near Nuttallburg, alt. 2000 ft.—L. W. N.

G. auriculata, Michx.
Fields. Mongalia: near Little Falls, with pure white flowers.

CASTILLEJA, L. f.

C. coccinea(L.), Spreng. Painted Cup.
Sandy soils. Monongalia: along the Monongahela at Uffington, and below Morgantown. Randolph: near Valley Head. Preston: near Terra Alta. Hampshire: near Romney.

PEDICULARIS, L.

P. Canadensis, L. Louse-wort. M. & G.
Copses, woods and banks. Preston: near Terra Alta. Fayette: near Nuttallburg—L. W. N. Gilmer: near Glenville—V. M. Greenbrier: near White Sulphur Springs. Summers: near Hinton. McDowell: near Elkhorn.

MELAMPYRUM. L.

M. lineare, Lam. Cow-wheat. *M. Americanum*, Michx.
Rich, open woods. Preston: near Terra Alta.

OROBANCHACEÆ.

EPIPHEGUS, Nutt.

E. Virginiana(L), Bart. Beech-drops. Cancer-root.
Parasitic upon the roots of the beech. Wirt: near Elizabeth. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg—L. W. N. Monongalia: near Morgantown.

CONOPHOLIS, Wallr.

C. Americana(L.f.), Wallr. Cancer Root.
Oak woods. Among fallen leaves. Monongalia: along Decker's Creek and near Little Falls. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg—L. W. N. McDowell: near Elkhorn. Mercer: near Bluefield.

APHYLLON, Mitch.

A. uniflorum(L.), Gray. One-flowered Cancer-root. M. & G.
Damp woodlands and opens. Monongalia: near Morgantown. Wirt: near Elizabeth. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg—L. W. N.

BIGNONIACEÆ.

TECOMA, Juss.

T. radicans(L.), Juss. Trumpet-Creeper. M. & G.
Moist soil. Monongalia: near Little Falls. Mari n: near Fairmont. Fayette: near Nuttallburg—L. W. N. Summers: near Hinton. Mason: near Point Pleasant; and frequent throughout the State.

CATALPA, Juss.

C. Bignonioides, Walt. Indian Bean Tree. "Catawba." M. & G.
River banks. Marion: near Catawba, a place named after this tree, which would render it apparent that the tree was native here, which I hold to be true. Wood: near Leachtown. Gilmer: near DeKalb and along Leading Creek. Monongalia: near Ice's Ferry and Stewartown. Wirt: near Elizabeth. Upshur: along Big Sandy Run, alt. 1827 ft. Mason: near Point Pleasant.

ACANTHACEÆ.

RUELLIA, L.

R. ciliosa, Pursh.
Margins of woods. Wood: near Leachtown. Wirt: near Elizabeth. Calhoun: near Grantsville. Gilmer: near DeKalb. Lewis: along Stone Coal Creek. Upshur: near Laurentz. Nicholas: along the Gauley River. Kanawha: near Cannellton.

DIANTHERA, L.

D. Americana, L. Water Willow. L. W. N., M. & G.
In streams. Common throughout the State.

VERBENACEÆ.

VERBENA, L.

V. officinalis, L. Vervian.
Jefferson: near Harper's Ferry—M. & G.

V. urticæfolia, L. White Vervian. L. W. N., M. & G.
Waste or open grounds. Common throughout the State.

V. hastata, L. Blue Vervian. L. W. N.

Damp waste grounds and roadsides. Frequent throughout the State. In some places rare.

V. angustifolia, Michx. M. & G.

Roadsides and waste places. Throughout Jefferson County. Hardy: near Moorefield—G.

LIPPIA, L.

L. lanceolata, Michx. Frog Fruit.

Waste grounds. Ohio: near West Wheeling—M. & G. Mason: Banks of the Ohio River near Point Pleasant.

PHRYMA, L.

P. Leptostachya, L. Lop-seed. M. & G.

Rich open woods. Greenbrier: near White Sulphur Springs. Fayette: near Kanawha Falls—James; near Nuttallburg—L. W. N. Kanawha: near Charleston. Mason: near Point Pleasant; and frequent throughout the State.

LABIATÆ.

ISANTHUS, Michx.

I. brachiatus(L.), B. S. P. False Pennyroyal. *I, cæruleus*, Michx.

Mineral: opposite Cumberland, Md.—M. & G.

TEUCRIUM, L.

T. Canadense, L. Germander. Wood Sage.

Low grounds. Wood: ditches near Kanawha Station. Jackson: near Sandyville. Gilmer: near Glenville—V. M. Cabell: near Barboursville—James. Fayette: near Nuttallburg, profile of expanded flower resembles a deer's head—L. W. N. Monongalia: near Ice's Ferry. Hardy: near Moorefield—G.

COLLINSONIA, L.

C. Canadensis, L. Rich-weed. Stone-root.

Rich, damp woods. Randolph: along Staunton pike up Riffles Creek, alt 2700 ft. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg, some plants with elliptical leaves, acute at both ends 10 in. wide by 3½ inches long—L. W. N. Monongalia: near Camp Eden. McDowell: near Elkhorn.

PERILLA, L.

P. OCYMOIDES, L., *var.* **CRISPA.**
Waste ground. Monongalia: near Morgantown.

MENTHA, L.

M. VIRIDIS, L. Spearmint. G., V. M., M. & G.
Low grounds and damp places. Frequent, even at the higher altitudes.

M. PIPERITA, L. Peppermint. M. & G.
A frequent escape along springy brooklets. Gilmer: along Tanner's Fork. Randolph: on Point Mountain, alt. 3050 ft. Jackson: near Sandyville. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg, alt. 2000 ft—L. W. N. Summers: near Hinton.

M. SATIVA, L. Whorled Mint.
Monroe: banks of Greenbrier River—L. W. N.

M. Canadensis, L. Wild Mint.
Wet places. Randolph: along the road up Point Mountain, alt., 2325 feet. Fayette: near Nuttallburg, rare —L. W. N. Summers: near Hinton.

LYCOPUS, L.

L. Virginicus, L. Bugle Weed. L. W. N.
Low, wet grounds. Common throughout the State.

L. sinuatus, Ell.
Low, wet ground. Mason: near Point Pleasant.

CUNILA, L.

C. Mariana, L. Dittany.
Dry hillsides. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg—L. W. F. Wetzel: near Burton—M. & G.

KOELLIA, Moen. (1794.)
(Pycanthemum, Michx. 1803.)

K. flexuosa(Walt.). (*P. linifolium*, Pursh.)
Dry grounds. Wood: near Kanawha Station and Lockhart's Run. Fayette: near Kanawha Falls - James; near Nuttallburg—L. W. N. Preston: near Terra Alta. Summers: near Hinton. Monroe: near Alderson.

K. Torreyi(Benth.).
Dry soil. Fayette: near Nuttallburg—L. W. N. Summers: near Hinton.

K. clinopodioides(T. & G.)
Dry soil. Nicholas: near Beaver Mills, alt. 2125 ft.

K. Tullia(Benth.).
Open woods and banks. Fayette: near Nuttallburg, common—L. W. N.

K. incana(L.). Mountain Mint.
Dry soils, Wirt: near Burning Springs and Elizabeth. Monongalia: near Morgantown. Fayette: near Nuttallburg —L. W. N.

K. montana(Michx.).
Rocky river banks. Fayette: near Nuttallburg, rare. Not found in 1891—L. W. N.

HEDEOMA, Pers.

H. pulegioides(L.). Pers. American Pennyroyal. L. W. N., M. & G.
Dry fields and woods. Common throughout the State.

CALAMINTHA, Mœnch.

C. Clinopodium, Benth. Basil. M. & G.
Dry soils. Upshur: near Buckhannon. Fayette: near Nuttallburg, rare—L. W. N. Randolph: near Crickard P. O.

MELISSA, L.

M. OFFICINALIS, L. Balm.
Escaped from gardens. Kanawha: up 8-Mile Creek. Fayette: near Nuttallburg—L. W. N.

SALVIA, L.

M lyrata, L. Sage.
Meadows. Monongalia: near Morgantown. Fayette: near Nuttallburg L. W. N. Gilmer: near Glenville—V. M. Mercer: near Ingleside.

MONARDA, L.

M. didyma, L. Bee-balm. Oswego-Tea. M. & G.
Moist places. Randolph: near Cheat Bridge, alt. 3350

ft.; near Valley Head. Mineral: near Davis. Grant and Tucker on W. Va. Central R. R. Monroe: near Alderson. Hardy: near Moorefield—G.

M. fistulosa, L. Wild Bergamont. M. & G.

Dry soils. Wirt: near Elizabeth. Gilmer: near DeKalb, abundant; near Glenville—V. M. Randolph: summit of Point Mountain, alt. 3700 ft. Monongalia: near Ice's Ferry. Fayette: near Nuttallburg—L. W. N.; near Kanawha Falls—James. Kanawha: near Coalburg—James. Greenbrier: near White Sulphur Springs. Marion: near Fairmont. Hardy: near Moorefield—G.

Var. **rubra**, Gray.

Moist grounds. Mineral: along Abraham's Creek. Summers: near Greenbrier Stockyards. Monroe: near Alderson.

Var. **mollis**(L.), Benth.

Shady places. Fayette: near Nuttallburg—L. W. N.

BLEPHILIA, Raf.

B. hirsuta, Benth. M. & G.

Fields and fence rows. Randolph: summit of Rich Mountain, alt. 3000 ft. Fayette: near Hawk's Nest—James. Preston: near Terra Alta.

AGASTACHE, Gron. (1762).
(Lophanthus, Benth, 1834.)

A. nepetoides(L.) Giant Hyssop.

Ohio: near Wheeling—M. & G.

CEDRONELLA, Moench.

C cordata, Benth.

Moist, shady ravines. Kanawha: near Charleston—Barnes. Fayette: near Kanawha Falls—James. Gilmer: near Glenville—V. M.; Prof. Brown. Randolph: summit of Point Mountain, alt. 3700 ft. Monongalia: near Round Bottoms; opposite Little Falls. Fayette: near Nuttallburg—L. W. N.

NEPETA, L.

N. CATARIA, L. Catnip. L. W. N., V. M., M. & G.

Roadsides and waste places. Common throughout the State.

Found at various points in the higher Alleghanies, remote from dwellings.

N. hederacea (L.), B. S. P. Ground Ivy. Gill-over-the-ground. *N. Glechoma*, Benth. L. W. N., M. & G.
Abundant throughout the settled portions of the State.

SCUTELLARIA, L.

S. lateriflora, L. Mad-dog Skull-cap. L. W. N., M. & G.
Wet shady places. Frequent throughout the State.

S. versicolor, Nutt., *var.* **minor**, Chapm.
Rich soil. Fayette: near Nuttallburg—L. W. N. On visiting Mr. Nuttall's station for this species, a moss covered boulder, I was impressed with the great beauty of this little skull-cap, which, in its mossy bed, resembled a bright blue bit of color upon a Fairy's palette.

S. saxatalis, Riddell. M. & G.
Moist shady banks. Fayette: near Nuttallburg—L. W. N.; along the north bank of the Great Kanawha River near Kanawha Falls.

S. serrata, Andrews.
Woodlands: Kanawha: near Charleston—Barnes. Putnam: near Buffalo. Fayette: near Nuttallburg—L. W. N.

S. canescens, Nutt. M. & G.
Ditches and moist places. Wirt: near Elizabeth. Kanawha: up 8 Mile Creek.

S. pilosa, L.
Dry mountain sides. Fayette: near Nuttallburg—L. W. N.

Var. **hirsuta**, Benth.
With the preceding. Fayette: near Nuttallburg—L. W. N.

S. integrifolia, L., *var.* **hyssopifolia**.
Low grounds. Wood: near Kanawha Station, abundant.

S. parvula, Michx.
Sandy banks. Wood: near Parkersburg—M. & G. Mason: near Point Pleasant.

S. galericulata,* L.
Wet shady places. Kanawha: near Charleston—Barnes.; near Pocataligo. Jackson: near Fisher's Point. Gilmer: near Glenville—Prof. Brown.

Forma **albiflora**.
Kanawha: near Charleston—Barnes.

S. nervosa, Pursh. M. & G.
Moist thickets. Monongalia: on The Flats near Morgantown.

BRUNELLA, L.

B. vulgaris, L. Heal-all. G., L. W. N., V. M., M. & G.
All situations. Common throughout the State.

Forma **albiflora**(Boggenhard), Britt.
Jackson: on Limestone Ridge.

PHYSOSTEGIA, Benth.

P. Virginiana(L.), Benth. False Dragon-head.
Wet places. Fayette: near Nuttallburg—L. W. N.; near Kanawha Falls—James.

MARRUBIUM, L.

M. VULGARE, L. Horehound. M. & G.
Waste grounds, escaped from gardens. Randolph: near Ford's. Jefferson: near Shepherdstown, plentiful.

STACHYS, L.

S. palustris, L. Hedge Nettle.
Wet grounds. Gilmer: near Glenville—Prof. Brown.

S. aspera, Michx.
Damp places. Fayette: near Nuttallburg—L. W. N.

Var. **glabra,** Gray.
Damp places. Mason, banks of the Ohio River near Point Pleasant, common.

S. cordata, Ridd.
Rocky thickets. Wirt: near Elizabeth.

GALEOPSIS, L.

G. TETRAHIT, L. Hemp Nettle.
Waste places. Preston: near Terra Alta.; near Cranberry Summit—M. & G.

LEONURUS, L.

L. CARDIACA, L. Motherwort.

Waste places near dwellings. Monongalia: near Ice's Ferry. Hardy: near Moorefield. Mercer: near Princeton. Jefferson: near Shenandoah Jc.

LAMIUM L.

L. AMPLEXICAULE, L, Dead Nettle.

Escaped from Gardens. Fayette: near Nuttallburg—L. W. N. Monongalia: plentiful on the College Campus.

TRICHOSTEMA, L.

T. dichotomum, L. Bastard Pennyroyal.

Dry fields. Mason: near Brighton. Hardy: near Moorefield—G.

PLANTAGINEÆ.

PLANTAGO, L.

P. MAJOR, L. Plantain.

Waste ground. Ohio: near Wheeling—M. & G. Fayette: Nuttallburg—L. W. N. Monongalia: Morgantown.

P RUGELII, Decne. Common Plantain. L. W. N., M. & G.

Common throughout the State, near dwellings.

P. LANCEOLATA, L. "Buck Plantain." "Ripple." "Buck-horn Plantain."

Becoming a common weed throughout the State; very little as yet however in Jefferson, Berkeley and Morgan counties. Greenbrier: near White Sulphur Springs. Fayette: near Nuttallburg—L. W. N. Mercer: near Princeton.

P. Virginica, L. White Plantain. M. & G.

Sandy soils. Fayette: near Nuttallburg, L. W. N. Monongalia: near Morgantown; and frequent throughout the State. Hardy: near Moorefield.

APETALÆ.

ILLECEBRACEÆ.

ANYCHIA, Rich.

A. Candensis(L.), B. S. P. (*A. capillacea*, D. C.)
Dry Woods. Fayette: near Nuttallburg, common—L. W. N.

PARONYCHIA, Tourn.

P. dichotoma, Nutt. Whitlow-wort.
Rocky places. Jefferson: near Harper's Ferry—Gray.

AMARANTACEÆ.

AMARANTUS. L.

A. HYPOCHONDRIACUS, L. Red Amaranth.
Waste places. Ohio: on Bogg's Island—M. & G. Monongalia: near Morgantown,

A. PANICULATUS, L.
Waste places. Monongalia: near Morganton. Hardy: near Moorefield—G.

A. RETROFLEXUS, L. Pigweed.
Ohio: on Bogg's Island—M. & G. Monongalia: near Morgantown.

A. CHLOROSTACHYS, Willd.
Gardens and waste places. Fayette: near Nuttallburg, common—L. W. N. Monongalia: near Morgantown. Hardy: near Moorefield—G.

A. ALBUS, L. Tumble-weed. M. & G.
Waste places. Monongalia: near Morgantown.

A. SPINOSUS, L. Thorny Amaranth.
Waste grounds. Kanawha: near Charleston. Putnam: near Buffalo. Mason: near Point Pleasant. Wood: near Parkersburg, abundant. Jefferson: near Shepherdstown.

CHENOPODIACEÆ.

CHENOPODIUM, L.

C. **ALBUM**, L. Lamb's Quarters. Pigweed. L. W. N., M. & G.
Roadsides and waste places, common throughout the State.

Var. **VIRIDE**, Moq.
Dry sandy hillsides. Fayette: near Nuttallburg, alt. 2000 ft., uncommon—L. W. N.

C. **HYBRIDUM**, L.
Dry sandy hillsides. Fayette: near Nuttallburg, apparently indigenous—L. W. N. Jefferson: near Shepherdstown.

C. **URBICUM**, L. M. & G.
Waste places, frequent.

C. **GLAUCUM**, L.
Waste places. Monongalia: near Ice's Ferry.

C. **BOTRYS**, L. Jerusalem Oak.
Ohio: near Wheeling. Jefferson: Shepherdstown.

C. **AMBROSIOIDES**, L. Mexican Tea. M. & G.
Waste places. Common. Kanawha: along Great Kanawha River. Taylor: near Grafton. Wood: near Parkersburg.

Var. **ANTHELMINTICUM**(L.), Gray. Worm weed.
Plentiful along the Great Kanawha River. In Kanawha, Putnam and Mason counties. Nayette: near Nuttallburg—L. W. N. Jackson: along C. & P. pike.

PHYTOLACCACEÆ.

PHYTOLACCA, L.

P. **decandra**, L. Poke. Scoke. Garget. G., L. W. N., M. & G.
All situations, even in higher mountains. Common throughout the State.

POLYGONACEÆ.

ERIGONUM, Michx.

E. **Alleni**, Wats.
Greenbrier: near White Sulphur Springs—T. F. Allen.

POLYGONUM, L.

P. ORIENTALE, L. Prince's Feather — M. & G.
Escaped to waste places. Lewis: near Weston. Monongalia: near Morgantown. Fayette: near Nuttallburg, rare —L. W. N. Mineral: near Piedmont.

P. Pennsylvanicum, L. — G., L. W. N.
Low grounds. Common throughout the State.

P. PERSICARIA, L. Lady's Thumb. — M. & G.
Waste grounds. Lewis: near Weston. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg—L. W. N. Mason: near Point Pleasant. Wood: near Parkersburg. Hardy: near Moorefield—G.

Forma **albiflora.**
A pure white-flowered form abundant near Point Pleasant.

P. Hydropiper, L. Smartweed. Water Pepper.
Wet grounds. Monongalia: near Morgantown. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg—L. W. N. Ohio: near Wheeling—M. & G.

P. acre, H. B. K. — G., L. W. N.
Wet places. Common throughout the State.

P. hydropiperoides, Michx. Mild Water-pepper.
Swampy places. Common throughout the State.

P. Virginianum, L. — L. W. N.
Thickets and in rich soils. Common throughout the State.

P. aviculare, L. Door-weed. "Goose-grass." — L. W. N.
About dwellings and roadsides. Common throughout the State.

P. erectum, L. — L. W. N.
With the last, especially in streets.

P. tenue, Michx.
Dry pastures. Wood: near Kanawha Station. Monongalia: near Morgantown. Taylor: near Grafton, and common throughout the State.

P. sagittatum, L. Tear-thumb. — G., L. W. N., M. & G.
Wet places. Common throughout the State.

P. arifolium, L.
Low grounds. Berkeley: near Martinsburg. Monongalia: near Morgantown, and elsewhere frequent.

P. Convolvulus, L. Black Bindweed.
Gardens and waste places. Fayette: near Nuttallburg —L. W. N. Mason: near Point Pleasant.

P. dumetorum, L., *var.* **scandens**, L., Gray. Climbing False Buckwheat. G., L. W. N., M. & G.
Low grounds along streams.

FAGOPYRUM, Gærtn.

F. esculentum, Moench. Buckwheat. G. W. N., M. & G.
Waste grounds and cultivated fields. A frequent escape.

RUMEX, L.

R. Brittanicus, L. Water Dock.
Wet places. Ohio: on Bogg's Island—M. & G. Berkeley, near Martinsburg.

R. crispus, L. Curled Dock. M. & G.
Waste places and cultivated fields. Frequent.

R. obtusifolius, L. Bitter Dock. L. W. N.
Waste grounds and cultivated fields, common.

R. crispus x obtusifolius.
Waste places. Monongalia: streets of Morgantown.

R. sanguineus, L. Bloody Dock.
Damp places in waste grounds. Berkeley: near Martinsburg.

R. conglomeratus, Murray.
Shady places. Fayette: near Nuttallburg—L. W. N.

R. Acetosella, L. Horse Sorrel. J., L. W. N., V. M., M. & G.
Abundant everywhere; even along paths in the dense spruce forests of the higher mountains.

ARISTOLOCHIACEÆ.

ASARUM, L.

A. Canadense, L. Wild Ginger. "Colic Root." M. & G.
Rich woods. Wirt: near Burning Springs. Gilmer:

near Glenville—V. M.; Prof. Brown. Jefferson: near Flow inn Spring Mill. Fayette: near Nuttallburg—L. W. N. Monongalia: near Uffington and Morgantown. McDowell: near Elkhorn. Mercer: Bluestone Jc., and common throughout the State.

A. Virginicum, L.
Rich soil. Grant: near Bayard. Tucker: along Black Water. Gilmer: near Glenville—V. M.; Prof. Brown. Greenbrier: near White Sulphur Springs. McDowell: near Elkhorn. Mercer: Bluestone Jc. and Bluefield.

ARISTOLOCHIA, L.

A. Serpentaria, L. Virginia Snakeroot. M. & G.
Rich woods. Wirt: near Burning Springs. Randolph: near Ford's and on Point Mountain. Gilmer: near Glenville—Prof. Brown. Grant: near Bayard. Tucker: near Davis. Mineral: near Keyser—W. Fayette: near Nuttallburg—L. W. N.

A. Sipho, L'Her. Dutchman's Pipe.
Rich woods, frequent throughout the State. Abundant in the following localities. Randolph: on Point Mountain. Grant: near Bayard. Gilmer: near Glenville—V. M., Prof. Brown. Fayette: near Nuttallburg—L. W. N. Mercer: Ingleside.

PIPERACEÆ.

SAURURUS, L.

S. cernuus, L. Lizard's Tail.
Streams. Jefferson: near Harper's Ferry—M. & G. Brooke: near Wellsburg. Fayette: near Nuttallburg—L. W. N.

LAURINEÆ.

SASSAFRAS, Nees.

S. officinale, Nees. Sassafras. G., L. W. N., V. M., M. & G.
Thickets and opens. Abundant throughout the State.

LINDERA, Thumb.

L. Benzoin(L.), Meisn. Wild Allspice. Spice-bush. L. W. N., V. M., M. & G.
Low woods. Common throughout the State.

THYMELÆACEÆ.

DIRCA, L.

D palustris, L. Leatherwood.

Damp woods. Jackson: near Ripley. Wirt: near Elizabeth. Calhoun: near White Pine and Brookville. Greenbrier: White Sulphur Springs. Fayette: near Nuttallburg—L. W. N.

LORANTHACEÆ.

PHORADENDRON, Nutt.

P. flavescens(Pursh.), Nutt. American Mistletoe.

Parasitic on Sugar-Maple and Black Locust, along the Great Kanawha River in Fayette county. On Black Walnut and Elm in Kanawha county. On Elms in Mason county, and in Wood near Parkersburg. On Elms and Hickories, along the Ohio and Great Kanawha rivers, in Cabell county.

SANTALACEÆ.

PYRULARIA, Michx.

P. pubera, Michx.

Rich woods. McDowell: near Elkhorn.

EUPHORBIACEÆ.

EUPHORBIA, L.

E. glytosperma Engelm. var. **pubescens**, Engelm.

Sandy soil. Mason: banks of the Ohio river, near Point Pleasant. The only station so far known in the State.

E. maculata, L. Spotted Spurge. L. W. N., M. & G.

Arid soils. Common even in the higher Alleghanies.

E. Preslii, Guss. L. W. N., M. & G.

Dry soils and pastures. Common throughout the State, even in the higher Alleghanies.

E. MARGINATA, Pursh.

An escape from cultivation. Taylor: permanently established near Mannington—V. M. Monongalia: the Flats near Morgantown.

E. corollata, L. Flowering Spurge. M. & G.

Dry soils. Wirt: near Elizabeth. Lewis: along Leading Creek. Upshur: near Laurentz. Randolph: on Lone Sugar Knob, alt. 2,800 ft. Webster: Long Glade. Nicholas: Mumble-the-Peg Creek. Kanawha: along 8-Mile Creek; near Pocataligo. Jackson: Fisher's Point. Wood: on Limestone Ridge. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg, L. W. N. Grant: near Bayard. Monongalia: plentiful along Cheat River, near Camp Eden. Greenbrier: near White Sulphur Springs. Monroe, near Alderson. Summers: near Hinton. Mason: near Point Pleasant.

E. dentata, Michx.

Rich soil. Ohio: near Wheeling—M. & G.

E. Darlingtonii, Gray.

Damp woods. Pocahontas: along the mountains—A. D. Hopkins.

E. obtusata, Pursh.

Rich soil. Ohio: near Wheeling—M. & G.

E. Cyparissias, L. "Grave-yard-weed."

A frequent escape from cemeteries. Monongalia: near Morgantown. Cabell: near Huntington.

E. commutata, Englm.

Woodlands. Jefferson: near Harper's Ferry—M. & G.; near Shepherdstown. Mineral: near Keyser—W. along Knobby Mountains. Summers: near Hinton, abundant. Hardy: near Moorefield—G. Hampshire: near Romney.

E. Lathyris, L. "Mole-weed."

Escaped from gardens, where it is cultivated with the idea of keeping out moles. Randolph: roadside up Point Mountain.

ACALYPHA, L.

A. Virginica, L. M. & G.

Fields and waste places. Common throughout the state.

forma **intermedia**, mihi.

A form apparently uniting A. Virginica, L. with A. Caroliniana, Ell. especially in the matter of leaves and bracts, is found near Nuttallburg—L. W. N., and Hawk's Nest, as well as along New River opposite Hinton.

URTICACEÆ.

ULMUS, L.

U. fulva, Michx. Slippery Elm. M. & G.
Rich soils. Monongalia: near Morgantown, Laurel Point and Stumptown. Gilmer: near Glenville—V.M. Fayette: near Nuttallburg—L. W. N. Mason: near Point Pleasant. Summers: along Greenbrier river.

U. Americana, L. White Elm. L. W. N., V. M., M. & G.
Along rivers. Frequent throughout the State.

U. racemosa, Thomas. Corky Elm. M. & G.
Near streams. Monroe: near Alderson. Summers: along Greenbrier river.

CELTIS, L.

C. occidentalis, L. Hackberry.
Woods and river banks. Jefferson: near Shenandoah Junction. Monongalia: near Morgantown. Jackson: near Ripley. Fayette: near Nuttallburg—L. W. N.

CANNABIS, L.

C. SATIVA, L. Hemp.
Fields and waste places. Escaped from cultivation. Jackson: frequent.

HUMULUS, L.

H. LUPULUS, L. Hops.
Alluvial banks near streams. Very doubtfully native. Randolph: near Cricard. Marshall: near Moundsville. Marion: near Clements, and Catawba. Mineral: opposite Cumberland, Md.

MORUS, L.

M. rubra, L. Black Mulberry.
Rich woods. Wood, Wirt, Calhoun and Gilmer—V.M. along the Little Kanawha River. Jefferson: frequent throughout. Greenbrier: near White Sulphur Springs. Fayette: near Nuttallburg, no large trees noted—L. W. N.

M. ALBA, L. White Mulberry.
A frequent escape. Monongalia: near Morgantown. Jefferson: near Millville and Charlestown.

BROUSSONETIA.

B. PAPYRIFERA. Paper Mulberry. "Cut Paper."
Escaped from cultivation. Jefferson: near Flowing Spring Mill and Milltown. Kanawha: near Montgomery. Berkeley: near Martinsburg.

URTICA, L.

U. gracilis, Ait. Nettle. V. M., M. & G.
Moist shady places. Common.

U. URENS, L. Stinging Nettle.
Adventive. Hancock: near Holliday's Cove. Rare.

LAPORTEA, Gaud.

L. Canadensis(L.),Gaud. Wood Nettle.
Moist rich woods. Fayette: near Nuttallburg—L. W. N.; near Kanawha Falls—James. Frequent throughout the State.

PILEA, Lindl.

P. pumila(L.), Gray. Clear Weed. Rich Weed. L.W.N., M.&G.
Cool, moist, shady places. Common throughout the State.

BŒHMERIA, Jacq.

B. cylindrica(L.), Willd.
Damp places. Fayette: near Nuttallburg—L. W. N. Monongalia: near Uffington.

PLATANACEÆ.

PLATANUS, L.

P. occidentalis, L. Sycamore. Buttonwood. L.W.N. V.M., M.&G.
All soils. Common throughout the State.

JUGLANDEÆ.

JUGLANS, L.

J. cinerea, L. Butternut. White Walnut. L.W.N., V.M., M.&G.
Common throughout the State.

J. nigra, L. Black Walnut. L. W. N., V. M., M. & G.
Rich soils, even in the higher Alleghanies. A very common and valuable timber tree throughout the State.

HICORIA, Raf.

H. ovata,(Mill.), Britt. Shag or Shellbark Hickory (*Carya alba*, Nutt.) L. W. N., V. M., M. & G.
Low grounds, frequent throughout the State.

H. sulcata,(Nutt.) King Nut. (*Carya sulcata*, Nutt.)
Rich soil. Monongalia: near Ice's Ferry.

H. alba.(L.) Britt. White Heart Hickory. (*Carya tomentosa*, Nutt.) L. W. N., V. M.
Woods, frequent throughout the State.

H. glabra(Mill.), Britt. Pig Nut. (*Carya porcina*, Nutt.) L. W. N., V. M., M. & G.
Dry soils, frequent throughout the State.

H. microcarpa(Nutt.), Britt. (*Carya microcarpa*, Nutt.)
Woodlands. Fayette: near Nuttallburg—L. W. N.

H. minima(Marsh.), Britt. Bitter-nut. *Carya amara*, Nutt.
Low Woods. Greenbrier: near Fort Spring and Ronceverte.

CUPULIFERÆ.

BETULA, L.

B. lenta, L. Sweet Birch. Black Birch. L. W. N., M. & G.
Rich Woods. Common throughout the State. Grows very large in the mountains. One specimen near Cheat Bridge measure; 7 ft. 9 in. in diameter.

B. lutea, Michx.f. Yellow Birch.
Higher mountain woods. Grant: near Bayard. Tucker: near Hulings. Braxton: near Sutton. Randolph: near Pickens.

B. populifolia, Marsh. White Birch.
Poor soils. Gilmer: near Glenville—V. M. Randolph: near Winchester.

B. nigra, L. River Birch. Red Birch.
Along streams. Calhoun: along Little Kanawha River. Gilmer: near Glenville—V. M. Greenbrier: near

Fort Spring. Summers: near Greenbrier Stockyards; near Hinton. Kanawha: near Handley. Fayette: near Nuttallburg—L. W. N.; and common along streams throughout the central and southern counties.

ALNUS, L.

A. viridis, DC. Mountain Alder.

Along mountain streams, rare. Greenbrier: Columbia Sulphur Springs. Fayette: near Nuttallburg—L. W. N. Pocahontas: at Traveler's Repose. Randolph: along Cheat River.

A. serrulata, Willd. Smooth Alder.

Low grounds and along rivers. Common, especially in the glade regions.

CARPINUS, L.

C. Caroliniana, Walt. Blue or Water Beech.

Damp thickets and river banks. Wirt: near Elizabeth. Monongalia: near Morgantown, plentiful. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg—L. W. N. Summers: near Hinton. Marion: near Worthington. Jefferson: near Harper's Ferry—M. & G.

OSTRYA, Scop.

O. Virginiana, Mill., Willd. Lever Wood. Iron Wood. M. & G.

Rich woods and along streams. Wirt: near Elizabeth. Randolph: on Point Mountain; at first Top of Cheat there is a forest of this wood where trees are found in quantity from 1–3 feet in diameter. Webster: on Buffalo Bull Mountain. Greenbrier: near White Sulphur Springs. Summers: near Hinton. Marion: near Worthington. Fayette: near Nuttallburg—L. W. N.

CORYLUS, L.

C. Americana, Walt. Hazlenut. V. M., M. & G.

Thickets, frequent throughout the State.

C. rostrata, Ait. Beaked Hazlenut.

Mountainous regions. Upshur: summit on Staunton Pike. Randolph: near Fords.

QUERCUS, L.

Q. alba, L. White Oak. L. W. N., V. M., M. & G.

All soils, plentiful throughout the State.

Q. minor (Marsh.), Sarg. Post Oak. Iron Oak. (*Q. stellata*, Wang.)
Dry sterile soils, common.

Q. macrocarpa, Michx. Burr Oak. Mossy-cup Oak.
Rich soils. Tyler: near Long Reach.

Q. Prinus, L. Chestnut Oak. L. W. N., M. & G.
Rocky woods. Frequent throughout the State.

Q. Muhlenbergii, Engelm. Yellow Oak.
Rich, wooded valleys, especially in the mountains. Fayette: near Nuttallburg, rare—L. W. N.

Q. rubra, L. Red Oak. L. W. N., V. M., M. & G.
Common throughout the State, in both rich and poor soils.

Q. coccinea, Wang.
Woodlands. Fayette: near Nuttallburg, apparently a second growth—L. W. N.

Q. tinctoria, Bartr. Black Oak.
Dry woodlands. In large tracts in the Alleghanies of Mineral, Grant and Tucker counties. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg—L. W. N. Monongalia: near Ice's Ferry. Summers: near Hinton.

Q. palustris, DuRoi.
Along streams. Monongalia: near Stumptown.

Q. cuneata, Wang. Spanish Oak. *Q. falcata*, Michx.
Dry sandy soils throughout the western counties.

Q. nigra, L. Black Jack Oak. V. M.
Common in dry or heavy clay soils throughout the center of the State. Hardy: near Moorefield.

Q. ilicifolia, Wang. Holly-leaved Oak.
Sandy soils. Hampshire: near Romney. Hardy: near Moorefield.

Q. imbricaria, Michx. Laurel Oak.
Rich woods. Monongalia: near Morgantown and Laurel Point. Hardy: near Moorefield.

CASTANEA, Gaertn.

C. sativa, Mill., *var.* **Americana** (Michx.), Sargent. Chestnut. L. W. N.
Rocky woods and hills throughout the State.

C. pumila, Mill. Chinquapin.
Dry hills. Fayette: near Nuttallburg, alt. 2000 ft., frequent—L. W. N. Wayne: near Ceredo and Compton's Creek. Mercer: Beaver Spr., and Ingleside.

FAGUS, L.

F. ferruginea, Ait. Beech. L. W. N., V. M., M. & G.
General.

SALICINEÆ.

SALIX, L.

S. nigra, Marsh. Black Willow. L. W. N., M. & G.
Along streams, frequent or common. The principal willow of the State.

Var. **falcata**, Torr. Scythe-leaved Black Willow.
Along springy runs. Wirt: along Straight Creek. Lewis: along Leading Creek. Fayette: near Nuttallburg—L. W. N.

S. amygdaloides, And.
Fayette: near Nuttallburg—L. W. N.

S. ALBA, *var.* **VITELLINA**, Koch. White Willow. M. & G.
Scattered along streams in many parts of the State.

from protective or ornamental planting.

S. BABYLONICA, Tourn. Weeping Willow.
A frequent escape as in the last species. Monongalia: near Morgantown. Jefferson: near Flowing Spring and Milltown.

S. discolor, Muhl. Shining Willow.
Ohio: on Bogg's Island—M. & G.

S humilis, Marsh. Prairie Willow.
Glady regions. Webster: near Upper Glade. Preston: near Terra Alta.

S. sericea, Marsh. Silky Willow.
Along streams. Randolph: along Tygart's Valley River. Greenbrier: near White Sulphur Springs.

S. cordata, Muhl. Heart-leaved Willow.
Along streams, frequent. Lewis: along Leading

Creek. Wood: near Parkersburg. Mason: near Point Pleasant.

POPULUS. L.

P. ALBA, L. White Poplar. Abele. V. M.

A frequent escape from cultivation. In many places in the State, where the tree is planted for ornament, this species spreads widely from the root, thus often becoming a pest in lawns and along streets.

P. tremuloides, Michx. Aspen. Trembling Poplar. M. & G.

Wooded hillsides. Wirt: along Little Kanawha River. Calhoun: near Grantsville. Gilmer: near Glenville. Monongalia: near Marion; along the Monongahela River. Summers: near Riffe. Mason: near Point Pleasant:

P. grandidentata, Michx. Large-toothed Aspen.

Preston: near Cranberry Summit—M. & G. Ohio: near Wheeling—M. & G.

P. balsamifera. L., *var.* **CANDICANS** Ait., Gray. Balm of Gilead. M. & G.

Plentiful at Montana, along the Monongahela river in Marion Co. Monongalia: the Flats near Morgantown. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg, very likely introduced—L. W. N.

P. monilifera, Ait. Cottonwood.

Ohio: near Bogg's Run—M. & G. Mason: near Point Pleasant.

Corema Conradi. Torr., mentioned in Botanical Gazette, Vol. 2., P. 136, as occuring near Hawk's Nest, Fayette Co., is proven by Prof. James to be another species: and should therefore not yet be credited to this State.

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MONOCOTYLEDONÆ.

HYDROCHARIDEÆ.

ELODEA, Michx.

E. Canadensis, Michx. Water-weed.
Slow streams in slack water. Fayette: near Kanawha Falls—James. Putnam: near Buffalo.

ORCHIDEÆ.

MALAXIS, Sw. (1788).
(Microstylis, Nutt. 1818).

M. unifolia(Raf.) M. *ophioglossoides*, (Nutt.)
Rich woodlands. Greenbrier: near White Sulphur Springs—M. & G. Fayette: near Nuttallburg, rare—L.W.N.

LEPTORCHIS, Thou. (1809).
(Liparis, Rich. 1818).

L. liliifolia(L.), Tway-blade.
Rich woods. Monongalia: the Flats near Morgantown. Gilmer: near Glenville—V. M., Prof. Brown.

APLECTRUM, Nutt.

A. spicatum(Walt.), B. S. P. Adam-and-Eve. (*A. hiemale*, Nutt.)
Rich woods. Monongalia: rich woods near Morgantown. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg—L. W. N.

CORALLORHIZA, R. Br.

C. innata, R. Br. Coral Root.
Deep, rich woods. Grant: near Bayard. Fayette: near Nuttallburg, alt. 2000 ft,—L. W. N. Greenbrier: near White Sulphur Springs.

C. odontorhiza, (Sw.), Nutt.
Rich woods. Gilmer: near Glenviile—V. M. Fayette: near Nuttallburg, alt. 2000 ft.—L. W. N.

C. multiflora, Nutt.

Woodlands. Fayette: near Nuttallburg, alt. 2000 ft. —L. W. N.

GYROSTACHYS, Pers. (1807.)
(Spiranthes, Rich. 1818)

G. cernua(L.) Ladies Tresses.

Wet meadows. Fayette: near Nuttallburg, L. W. N. Monongalia: frequent throughout.

G. gracilis(Bigel.) Twisted Stock.

Sandy woods and fields. Fayette: near Nuttallburg, in hard, grassy ground—L. W. N. Monongalia: near Morgantown. Frequent throughout the State.

GOODYERA, R. Br.

G. repens, R. Br.

In deep evergeen forests. Grant: under Black Spruce near Bayard. Fayette: in deep Laurel thickets, rare, near Nuttallburg—L. W. N. McDowell: near Elkhorn.

G. pubescens, Willd. Rattlesnake Plantain. M. & G.

Rich woods. Monongalia: along Decker's Creek and Tibb's Run. Fayette: near Nuttallburg, rare—L. W. N. Nicholas: near Beaver Mills. McDowell: near Welch.

CALOPGON, R. Br.

C. tuberosus(L.), B. S. P. *C. pulchellus*, R. Br.

Hardy: near Moorefield—G.

POGONIA, Juss.

P. ophioglossoides (L.), Ker.

Boggy places. Preston: near Cranberry Summit—M. & G.

ORCHIS, L.

O. spectabilis, L. Showy Orchis.

Rich woods. Monongalia: near Morgantown. Gilmer: near Glenville—V. M., Prof. Brown. Fayette: near Nuttallburg, rare—L. W. N. McDowell: near Elkhorn.

HABENARIA, Willd.

H. tridentata (Willd.), Hook. Rein Orchis.

Wet places. Webster: in Long Glade. Fayette: near Nuttallburg—L. W. N.

H. flava(L.), Gray. *H. virescens*, Spr.
Wet places. Webster: in Long Glade.

H. orbiculata(Pursh), Torr.
Rich woods. Randolph: near summit Rich Mountain.

H. ciliaris(L.), R.Br. Yellow Fringed Orchis.
Wet sandy bogs. Webster: Welch and Long Glades. Preston: near Terra Alta. Fayette: near Nuttallburg, alt. 2000 ft., rare—L. W. N. Hardy: near Moorefield—G.

H. lacera(Michx.), R.Br. Ragged Fringed Orchis.
Bogs and moist thickets. Wood: near Lockhart's Run, Preston: Cranberry Summit—M. & G.

H. psycodes(L.), Gray. Pink Fringed Orchis.
Wet places. Randolph: on Rich Mountain. Grant: near Bayard. Preston: near Terra Alta. Wayne: near Central City.

CYPRIPEDIUM, L.

C. parviflorum, Salisb. Small Lady's Slipper.
Rich woods. Monongalia: near Morgantown. Marion: near Opekiska and Fairmont. Gilmer: near Glenville—V. M.; Prof. Brown. Mineral: near Keyser—W. Hardy: near Moorefield—G.

C. pubescens, Willd. Large Lady's Slipper.
Low woods. Same stations as the last. Fayette: near Nuttallburg—L. W. N.

C. acaule, Ait. Moccasin Flower.
Dry or moist woods. Monongalia: near Cheat View, plentiful. Preston: near Reedsville. Gilmer: near Glenville—Prof. Brown. Fayette. near Nuttallburg, alt. 2000 ft., in laurel thickets—L. W. N. Marion: along the F. M. & P. R. R. Mineral: near Keyser—W. Kanawha: near Coalburg—James. Hardy: near Moorefield—G.

HÆMODORACEÆ.

ALETRIS, L.

A. farinosa, L. Star Grass. Colic Root.
Sandy moist soils. Webster: in Upper Glade. Fayette: near Nuttallburg—L. W. N.

IRIDEÆ.

IRIS, L.

I. versicolor, L. Blue Flag.
Ditches and wet lands. Preston: near Terra Alta and Reedsville.

I. verna, L. Dwarf Iris.
Hardy: near Moorefield—G.

I. cristata. Ait. Dwarf Crested Iris.
Rich woods. Monongalia: near Morgantown, plentiful. Gilmer: near Glenville—V. M., Prof. Brown. Fayette: near Nuttallburg—L. W. N. Marion: along the Monongahela River, plentiful.

SISYRINCHIUM, L.

S. angustifolium. Mill. Blue-eyed Grass. *S. Bermudianum*, Gray, not. L. M. & G.
Moist grassy places. Fayette: near Kanawha Falls—James; near Nuttallburg—L. W. N. Gilmer: near Glenville—V. M. Monongalia: near Morgantown, and elsewhere common.

S. anceps, Cav.
Grassy places. Fayette: near Nuttallburg—L. W. N.

AMARYLLIDEÆ.

HYPOXYS. L.

H. erecta, L. Star-Grass. Yellow-eyed Grass.
Open places. Fayette: near Nuttallburg, common—L. W. N. Lewis: Up Stone Coal Creek. Monongalia: along Cheat River near Camp Eden, plentiful. Hardy: near Moorefield—G. Mercer: near Bluefield.

DIOSCOREACEÆ.

DIOSCOREA. L.

D. villosa, L. Wild Yam-root. Colic-root. M & G.
Thickets and rich woods. Randolph: on Point Mountain, alt. 3450 ft. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg. Pistillate plants rare—L. W. N. Grant and Tucker plentiful in the mountain woods. Mon-

ongalia: plentiful. Greenbrier: near White Sulphur Springs. Summers: near Hinton. Hardy: near Moorefield. McDowell: near Elkhorn. Mercer: Bluestone—J. C.

LILIACEÆ.

SMILAX, L.

S. herbacea, L. Carrion Flower. M. & G.
Thickets. Monongalia: plentiful at the Flats. Fayette: near Nuttallburg, rare—L. W. N.

S. rotundifolia, L. Greenbrier. L. W. N., V. M., M. & G.
Thickets, too common throughout the State.

S. glauca, Walt.
Dry thickets. Kanawha: near Charleston—Barnes. Fayette: near Nuttallburg—L. W. N. Monongolia: along Cheat River near Ice's Ferry.

S. Pseudo-China, L.
Dry soils. Monongalia: plentiful on the Flats; near Morgantown.

S. hispida, Muhl. Bristly Sarsaparilla.
Rich soil. Marion: near Fairmont.

ASPARAGUS, L.

A. OFFICINALIS, L. Asparagus. M. & G.
Woods and opens: a frequent escape. Jefferson: near Shenandoah Junction, plentiful. Monongalia: plentiful along Cheat River, near Ice's Ferry, and at Stewartown. Mason: near Point Pleasant. Berkeley: near Martinsburg. Hardy: near Moorefield.

POLYGONATUM, Adans.

P. biflorum(Walt.), Ell. Small Solomon's Seal. G., L. W. N., M. & G.
Rich woods and wooded banks. Frequent generally.

P. commutatum(Schult.), Dietr. Solomon's Seal. (*P. giganteum*, Dietr.)
Edges of meadows. Nicholas: near Beaver Mills. Gilmer: near Glenville—V. M. Monongalia: the Flats near Morgantown. Fayette: near Nuttallburg—L. W. N.

STREPTOPUS, Michx.

S. roseus, Michx. Twisted Stalk.

Cold, damp woods. Upshur: along Sand Run. Preston: near Terra Alta. Tucker: near Blackwater Falls. Grant: near Bayard. Randolph: western slopes of Cheat Mountains.

DISPORUM, Salisb.

D. lanuginosum, Benth. & Hook. (*Prosartes lanuginosa,* Don.)

Rich woods. Monongalia: near Morgantown. Preston: near Terra Alta. Mineral: near Keyser—W. Fayette: near Nuttallburg—L. W. N. Grant: near Bayard. Mercer: Bluestone Jc.

UNIFOLIUM, Adans. (1763)
(Smilacina, Desf. 1798.)

U. racemosum(L.), Britt. False Solomon's Seal. L.W.N., V.M., M. & G.

Rich woods. Common throughout the State.

U. Canadense(Desf.), Greene. Wild Lily-of-the-Valley (*S. bifolia, var. Canadensis,* Gray). M. & G.

Low, rich woods. Common throughout the northern and eastern counties.

MAIANTHEMUM, Wigg.

M. Canadense, Desf. M. & G.

Rich woods. Fayette: near Nuttallburg—L. W. N. Monongalia: along Decker's Creek.

HEMEROCALLIS, L.

H. FULVA, L. Day-lily. "Eve's Thread".

Roadsides and fields. A frequent escape from cultivation. Monongalia: near Morgantown and Cassville. Hampshire: near Bloomery where "it has become widely scattered by ploughing."

ALLIUM, L.

A. VINEALE. L. Field Garlic.

Cultivated fields. Jefferson: a vile and abundant weed in wheat fields. Monongalia: along the Monongahela below Morgantown.

Reported as a weed from: Berkeley: near Oakton, Martinsburg and Hedgesville. Barbour: near Belington,

Braxton: near Lloydsville. Cabell: near Union Ridge. Doddridge: near Smithton. Grant: near Medley. Greenbrier: near Trout Valley and White Sulphur Springs. Hampshire: near Slanesville, Three Churches, Capon Bridge, Bloomery, Dillon's Run, Higginsville and Springfield. Harrison: near Good Hope and Bridgeport. Hardy: near Wardensville and Moorefield. Jefferson: near Summit Point, Mohler's, Leetown, Charlestown. Ripon, Middleway and Kabletown. Jackson: near Sandy. Kanawha: near Blandon. Lincoln: near Hamlin. Mercer: near Princeton, and Concord Church. Marion: near Barracksville and Gray's Flat. Monongalia: near Morgantown. Ohio: near West Liberty. Preston: near Terra Alta, Reedsville, Amblersburg and Independence. Ritchie: near Ritchie C. H. Roane: near Walnut Grove. Summers: Talcott. Taylor: near Knottsville, Thornton and Grafton. Upshur: near Kanawha Head. Wayne: near Adkin's Mills. Wetzell: near Endicott and Blake. Wirt: near Reedy Ripple. Wood: near Waverly, Blennerhassett and Rockport.

A. tricoccum, Ait. Wild Leek. "Ramps." M. & G.
Rich mountain woods. Grant: near Bayard, abundant. Tucker: abundant along Blackwater Fork of Cheat. Greenbrier: near White Sulphur Springs.

A. cernuum, Roth. Wild Onion.
Greenbrier: near White Sulphur Springs. Fayette: near Nuttallburg—L. W. N. Ohio: near Wheeling—M. & G. Summers: near Hinton. Monongalia: near Camp Eden, and banks of Decker's Creek.

A. Canadense, Kalm. Wild Garlic.
Ohio: near Wheeling—M. & G. Fayette: near Loup Creek—James.

CAMASSIA, Lindl.

C. Fraseri, Torr. Wild Hyacinth.
Rich ground. Ohio: near Wheeling—M. & G. Gilmer: near Glenville—V. M.

MUSCARI, Mill.

M. BOTRYOIDES(L.), Mill. Grape Hyacinth.
Escaped from gardens. Monongalia: near Uffington. Gilmer: near Glenville—V. M.

ORINTHOGALUM, L.

O. UMBELLATUM, L. Star of Bethlehem. M. & G.
Escaped from gardens. Monongalia: abundant and

persistent on the line of the F., M. & P. R. R. from Morgantown to Coburn's Creek. Gilmer: near Glenville—V. M.

LILIUM, L.

L. Philadelphicum, L. Wild Red Lily. "Glade Lily." V. M., M. & G.

Dry or damp grounds. Monongalia: in Clinton District—M. H. Brown; near Stewartown, and Ice's Ferry. Marion; along the F., M. & P. R. R. Gilmer: near Glenville—V. M. Webster: in the glades, where it is called "Glade Lily." Hardy: near Moorefield—G. Fayette: near Nuttallburg—L. W. N.

L. superbum, L. Turk's-cap Lilly. M. & G.

Rich, low grounds. Randolph: summit Point Mountain, alt. 3700 ft. Monongalia: near Morgantown and Stewartown. Hardy: near Moorefield—G.

L. Canadense, L. Wild Yellow Lily. M. & G.

Moist meadows. Calhoun: along Laurel Run. Gilmer: near Glenville—V. M. Randolph: summit Point Mountain, alt. 2125 ft. Monongalia: near Ice's Ferry.

L. TIGRINUM, Ker. Tiger Lily. M. & G.

Established from gardens. Jefferson, Berkeley, Morgan, Hampshire and Mineral: along the B. & O. R. R. Calhoun: near Brookville. Monongalia: near Morgantown.

ERYTHRONIUM, L.

E. Americanum, Ker. Yellow Adder's Tongue. Dog's Tooth Violet. M. & G.

Rich open woods along streams. Monongalia and Marion: along the Monongahela River. Gilmer: near Glenville—V. M., Prof. Brown. Fayette: near Nuttallburg—L. W. N. Frequent or common throughout the State. Hardy: near Moorefield—G.

CHAMÆLIRIUM, Willd.

C. luteum (L.), Gray. Blazing Star. Devil's-bit.

Glades. Preston: near Terra Alta and Kingwood. Webster: in Welsh, Long and Collett's Glades. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg—L. W. N.

UVULARIA, L.

U. perfoliata, L. Bellwort.

Rich woods. Marion and Monongalia: along the

Monongahela river. Gilmer: near Glenville—V. M., Prof. Brown. Fayette: near Nuttallburg—L. W. N.

U. sessilifolia, L. *Oakesia sessilifolia* (L.), Wats.
Low rich woods. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg—L. W. N. Mercer: near Beaver Spr.

CLINTONIA, Raf.

C. borealis(Ait.), Raf. Clinton's Lily.
Cold damp woods. Grant: near Bayard. Preston: in Laurel hills. Tucker: near Davis.

C. umbellata, Torr. M. & G.
Rich woods. Randolph: on Rich Mountains. Grant: near Bayard Tucker: in Land of Canaan. Gilmer: near Glenville—Prof. Brown, V. M. Monongalia: near Morgantown. Kanawha: near Coalburg—James. Fayette: near Nuttallburg—L. W. N. Hardy: near Moorefield—G. McDowell: near Elkhorn. Mercer: Bluestone Jc.

MEDEOLA. L.

M. Virginica, L Indian Cucumber. M. & G.
Rich, damp woods. Upshur: along Sand Run. Grant and Tucker: in the mountain woods, plentiful. Gilmer: near Glenville—V. M. Monongalia: near Morgantown. Kanawha: near Coalburg—James. Fayette: near Nuttallburg—L. W. N., and elsewhere frequent. McDowell: near Elkhorn.

TRILLIUM, L.

T. sessile, L. Sessile-flowered Purple Trillium. M. & G.
Moist woods. Monongalia and Marion: abundant along the Monongahela river. Gilmer: near Glenville—Prof. Brown.

T. erectum, L. Purple Trillium. L. W. N., V. M., M. & G.
Rich woods. Throughout the northern and eastern portions of the State. McDowell: near Elkhorn.

Var. **album**, Pursh.
Monongalia: near Morgantown. Gilmer: near Glenville—V. M., Prof. Brown. Taylor: near Valley Falls—N. S. Hayes.
(See remarks under next form.)

Var. **declinatum.**

Gilmer: near Glenville—V. M. Mason: near Point Pleasant. Jackson: near Ravenswood.

(NOTE:—This form appears to be sufficiently different from T. erectum, and T. cernuum, to retain it: otherwise I could not list the specimens gathered.)

T. grandiflorum, Salisb. White Trillium. M. & G.

Rich woods. Abundant throughout the northern counties. Gilmer: near Glenville—V. M., Prof. Brown. Fayette: near Nuttallburg—L. W. N. McDowell: near Elkhorn.

T. cernuum, L. Wake Robin.

Moist woods. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg—L. W. N.

T. nivale, Riddell. Dwarf White Trillium.

In moss of wet rocks. Monongalia: along Quarry Run.- Grant: along Buffalo Creek. Randolph: along runs feeding Shaver's Fork of Cheat. Tucker: along Beaver Creek, and Blackwater Fork of Cheat.

T. erythrocarpum, Michx. Painted Trillium.

Cold deep ravines along runs. Grant: near Bayard. Randolph: Cheat River: Tucker: along Black Water Fork. Fayette: near Nuttallburg, alt. 2000 ft., rare—L. W. N. McDowell: near Elkhorn. Taylor: near Valley Falls—N. S. Hayes. Mercer: Bluestone Jc.

MELANTHIUM. L.

M. Virginicum, Bunch-flower.

Glades. Preston: near Terra Alta and in Morgan's Glade. Monongalia: glades near Booth's Creek. Webster: Second Glade. Nicholas: Collett's Glade.

M. parviflorum(Michx.), Watson.

Greenbrier: near White Sulphur Springs—M. & G,

VERATRUM, L.

V. viride, Ait. American White Hellebore. M. & G.

Rich wet spots in deep mountain woods. Randolph: on Point Mountain. Webster: Buffalo Bull Mountain. Grant and Tucker: common along streams.

CHROSPERMA, Raf. (1825)
(Amianthium, Gray 1837)

C. muscætoxicum (Walt.) Fly Poison.
Low rich grounds. Monongalia: Ice's Ferry. Preston: near Terra Alta.

COMMELINACEÆ.

TRADESCANTIA, L.

T. Virginica, L. Spiderwort.
Rich grounds. Kanawha: near Charleston—Barnes. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg—L.W.N. Wirt. along Straight Creek and near Burning Springs. Hardy: near Moorefield—G.

T. pilosa, Lehm. Hairy Spiderwort.
On boulders. Wirt: abundant beyond Burning Springs, and along Straight Creek.

COMMELINA, L.

C. Virginica, L. Day Flower.
Damp opens. Fayette: near Nuttallburg, rare—L.W.N.

JUNCACEÆ.

JUNCUS, L.

J. effusus, L. Soft Rush. M. & G.
Marshy ground. Kanawha: near Charleston—James. Fayette: near Nuttallburg—L. W. N. Common throughout.

J. setaceus, Rostk.
Fayette: near Loup Creek(?)—James.

J. marginatus, Rostk.
Moist sandy soils. Kanawha: near Charleston—James. Common throughout.

Var. **paucicapitatus**, Englm.
Fayette: near Nuttallburg—L. W. N.

J. tenuis, Willd. "Poverty Grass." L. W. N.
Roadsides and ditches. Abundant throughout the State.

J. acuminatus, Michx. L. W. N., M. & G.

Damp places. Monongalia and Marion: on the Monongahela River. Webster: in Welch and Long Glades. Fayette: near Nuttallburg.

J. nodosus. L.

Fayette: near Nuttallburg—L. W. N.

J. Canadensis, J. Gay.

Monongalia: near Little Falls. Fayette: near Nuttallburg—L. W. N.

LUZULA. DC.

L. vernalis (L.), DC.

Ohio: on Thomas's Hill near Wheeling—M. & G. Fayette: near Nuttallburg—L. W. N.

L. campestris (L.), DC.

Ohio: near Benwood—M. & G. Tyler: near Long Reach. Fayette: near Nuttallburg—L. W. N. Monongalia: near Morgantown.

TYPHACEÆ.

TYPHA, L.

T. latifolia, L. Cat Tails.

Ditches and swampy spots. Gilmer: near Glenville—V. M. Preston: near Terra Alta. Morgan: near Hancock. Monongalia: near the Dille farm.

SPARGANIUM, L.

S. eurycarpum. Engelm. Bur-reed.

Borders of streams and still waters. Webster: in Welch Glade. Greenbrier: near White Sulphur Springs.

AROIDEÆ.

ARISÆMA. Mart.

A. triphyllum (L.), Torr. Jack-in-the-Pulpit. V. M., L. W. N., M. & G.

Rich, damp woods. Common throughout the State.

A. Dracontium (L.), Schott. Green Dragon.

Low grounds. Gilmer: near Glenville—V. M.

SPATHYEMA, Raf. (1808.)
(Symplocarpus, Salisb. 1812.)

S. foetida(L.), Raf. Skunk Cabbage.

Boggy meadows. Preston: near Terra Alta. Monongalia: on the Dille farm.

Reported from: Brooke: near Wellburg and Fowlers. Berkeley: near Martinsburg and Hedgesville. Barbour: near Belington. Cabell: near Milton. Grant: near Medley, Greenland, Mount Storm, Maysville and Petersburg. Greenbrier: near Trout Valley and Fort Spring. Hampshire: near Slanesville and Capon Bridge. Harrison: near Lost Creek, Bridgeport and Good Hope. Hardy: near Wardensville and Old Fields. Hancock: near Fairview and New Cumberland. Jefferson: near Kabletown and Summit Point. Jackson: near Odaville. Lewis: near Walkersville. Mercer: near New Bramwell and Princeton. Mason: near Maggie. Mineral: near Blaine. Marion: near Gray's Flats. Marshall: near St. Joseph and Glen Easton. Ohis: near West Liberty. Pocahontas: near Lobelia. Pleasants: near Schultz. Preston: near Terra Alta, Masontown, Eglon and Amblersburg. Randolph: near Lee Bell, Kerens and Cricard. Roane: near Clio. Summers: near Talcott and Clayton. Taylor: near Knottsville. Upshur: near Kanawha Haad and Hemlock. Wayne: near Adkin's Mills. Wetzel: near Littleton, Pine Grove and Blake. Wirt: near Burning Spring, Evelyn and Reedy Ripple. Wood: near Rockport. Webster: near Replete.

ACORUS, L,

A. Calamus L. Calamus. Sweet-flag. M. & G.

Swampy places. Lewis: along Stone Coal Creek. Randolph: near Valley Bend, Cricard, and on Point Mountain, alt. 3050 ft. Gilmer: near Glenville—V. M. Berkeley: near Martinsburg.

LEMNACEÆ.

LEMNA, L.

L. minor, L. Duck-weed.

Stagnant waters. Putnam: near Buffalo.

ALISMACEÆ.

ALISMA, L.

A, Plantago, L. Water Plantain. M. &. G.

Wet ditches. Monongalia: near Ice's Ferry. Sum-

mers: near Hinton. Greenbrier: near White Sulphur Springs.

SAGITTARIA, L.

S. sagittæfolia, L., [illegible] **hastata** Pursh Britt. Arrow-head. M. & G.

In water or very wet places. Randolph: near Beverly. Summers: near Hinton. Greenbrier; near White Sulphur Springs. Wood: near Parkersburg. Marion: near Clements. Fayette: near Nuttallburg—L. W. N. Berkeley: near Martinsburg.

forma **angustifolia** (Engelm.), Britt.

Wet places. Putnam: near Buffalo. Mason: near Point Pleasant.

S. graminea, Michx.

Summers: shores of New River near Hinton.

NAIADACEÆ.

POTAMOGETON, L.

P. fluitans, Roth. Pond Weed. (*P. lonchites*, Tuck.)

In rivers and streams. Randolph: near Tygart's Valley River, near Huttonsville. Summers: New River: near Hinton:

CYPERACEÆ.

CYPERUS, L.

C. flavescens, L. Galingale.

Low grounds. Monongalia and Marion: along the Monongahela River. Mason: near Point Pleasant. Fayette: near Nuttallburg—L. W. N.

C. diandrus, Torr.

Fayette: near Nuttallburg—L. W. N.

C. esculentus, L. Edible Galingale.

Preston: near Rowlesburg—M. & G.

C. strigosus, L. Lank Galingale.

Low grounds. Jackson: near Sandyville. Monongalia: near Morgantown. Fayette: near Nuttallburg—L. W. N.

C. refractus, Engelm.

Fayette: near Hawk's Nest—Porter.

C. Lancastriensis, Porter,
Summers: shores of New River, near Hinton.

KYLLINGA, Rott.

K. pumila, Michx.
Fayette: near Nuttallburg—L. W. N.

DULICHIUM, Pers.

D. spathaceum(L.), Pers.
Along streams. Randolph: Tygart's Valley River near Huttonsville. Fayette: near Nuttallburg—L. W. N.

ELEOCHARIS, R. Br.

E. tuberculosa(Michx.), R. & S.
Sands of New River. Fayette: near Nuttallburg—L. W. N.

E. ovata(Roth.), R. & S. M. & G.
Muddy places. Upshur: near Buckhannon. Randolph: Tygart's Valley River. Fayette: near Kanawha Falls—James; near Nuttalburg—L. W. N.

E. palustris(L.), R. & S.
Ohio: near Wheeling—M. & G. Fayette—near Nuttallburg—L. W. N.

Var. **glaucescens**(Willd.), Gray.
Jefferson: near Harper's Ferry—M. & G

E. tenuis(Willd.), Schult. "Kill Cow." "Poverty Grass." M. & G., L. W. N.
Damp places, abundant everywhere.
Note.—The above names are applied along Tygart's Valley River, where in places this species grows so abundant as to take whole fields, and as cattle will not thrive upon it, these names suggested themselves.

E. acicularis(L.), R. & S.
Jefferson: near Harper's Ferry—M. & G.

FIMBRISTYLIS, Vahl.

F. autumnalis(L.), Roem. & Schult.
Fayette: near Nuttallburg—L. W. N.

SCIRPUS, L.

S. pungens, Vahl.
Jefferson: near Harper's Ferry—M. & G.

S. lacustris, L.
Glady places. Fayette: near Nuttallburg—L. W. N.

S. sylvaticus, L.
Glady places. Fayette: near Nuttallburg—L. W. N.

S. atrovirens, Muhl. M. & G.
Boggy places. Monongalia: along the Monongahela River. Fayette: near Nuttallburg—L. W. N.

S. polyphyllus, Vahl. L. W. N.
Randolph: along Tygart's Valley River. Fayette: near Nuttallburg.

ERIOPHORUM, L.

E. lineatum (Michx.), Benth. & Hook. Cotton Grass.
Low grounds. Monongalia: along Falling Run, above the campus.

E. cyperinum, L. Wool Grass. L. W. N.
Wet meadow lands. Monongalia, frequent. Upshur: near Buckhannon. Webster: in Long Glade. Kanawha: up 8-Mile Creek.

E. Virginicum, L. L. W. N.
Damp places. Fayette: near Nuttallburg. Preston: near Cranberry Summit—M. & G.

RYNCHOSPORA, Vahl.

R. glomerata (L.), Vahl. Beak-rush. L. W. N.
Low grounds. Webster: Upper Glade. Monongalia: near Morgantown. Fayette: near Nuttallburg.

CAREX, L.

All the species of this genus have passed through the hands of Prof. Bailey, who kindly identified them for this Flora.

C. folliculata, L.
Margins of streams. Tucker: near Falls of Blackwater.

C. intumescens, Rudge.

Wet places. Fayette: near Nuttallburg. Tucker: near Falls of Blackwater. Preston: near Terra Alta.

C. Grayii, Carey. Gray's Sedge.

Meadows and copses. Upshur: near Beech Fork.

C. lupulina, Muhl. Hop Sedge.

Wet places. Upshur: near Laurentz.

C. lurida, Wahl. Pale Sedge. (*C. tentacula*, Muhl.)

Swampy spots. Monongalia: along Falling Run. Wood: near Lockhart's Run. Fayette: near Nuttallburg—L. W. N.

Var. **gracilis**, Bailey. Slender, Pale Sedge.

On mossy boulders. Webster: along Buffalo Bull Mountain, alt. 2575 feet. Tucker: near Falls of Blackwater.

C. stenolepis, Torr.

Damp meadows. Monongalia: along Falling Run. Fayette: near Nuttallburg—L. W. N.

C. squarrosa, Dewey.

River banks. Monongalia: mouth of Falling Run. Fayette: near Nuttallburg—L. W. N.

C. stricta, Lam.

Sphagnum Swamp. Fayette: near Nuttallburg—L. W. N.

C. torta, Boott.

Cold damp places. Fayette: near Nuttallburg—L.W.N.

C. prasina, Wahl.

Fayette: bed of Keeney's Creek, near Nuttallburg—L. W. N.

C. crinita, Lam. L. W. N., M. & G.

Damp swales. General throughout the State even in the higher mountains.

C. CRINITA x C. PRASINA ? Bailey.

Fayette: along a run in Sugar Camp Hollow—L.W.N.

C. virescens, Muhl.

Banks and copses. Wood: near Lockhart's Run.

Var. **costata**, Dewey.

Banks. Fayette: near Nuttallburg—L. W. N.

C. triceps, Michx., *var.* **hirsuta,** Bailey.

Dry pastures. Wood: near Kanawha Station. Fayette: woodland border of swamp near Nuttallburg—L. W. N.

C. debilis, Michx., *var.* **Rudgei,** Bailey.

On mossy boulders. Randolph: summit of Rich Mountain, alt. 2850 feet; undrained meadows of Tygart's Valley River; Point Mountain, on perfectly dry rock, alt. 3650 ft.

A very common sedge in the mountains on mossy boulders and along runs. Beautiful growths occur all along the Blackwater Fork of Cheat. Fayette: near Nuttallburg—L. W. N.

C. venusta, Dewey, *var.* **minor,** Boeckl.

Fayette: near Masterton's swamp, Nuttallburg—L. W. N.

C. gracillima, Schw.

Low grounds. Tucker: near Falls of Blackwater. Fayette: near Nuttallburg—L. W. N.

C. grisea, Wahl., *var.* **angustifolia,** Boott.

Fayette: on banks near Nuttallburg—L. W. N.

C. glaucodea, Tuck.

Meadows: Fayette near Nuttallburg—L. W. N.

C. laxiflora, Lam.

Ohio: on Thomas Hill near Wheeling.

Var. **latifolia,** Boott.

Deep woods. Monongalia: banks of Day Creek. Wirt: banks of Straight Creek. Fayette: near Nuttallburg—L. W. N.

Var. **patulifolia,** Carey.

Fayette: shady bank, near Nuttallburg—L. W. N.

C. digitalis, Willd.

In deep woods. Grant: near Bayard. Fayette: near Nuttallburg—L. W. N.

C. laxiculmis, Schw.

Glady places. Fayette: near Nuttallburg—L. W. N.

C. plantaginea, Lam.

Rich wood. Fayette: near Nuttallburg—L. W. N.

C. varia, *var.* **colorata**, Bailey.
Fayette: near Nuttallburg—L. W. N.

C. Pennsylvanica, Lam.
Ohio: near Wheeling—M. & G.

C. communis, Bailey.
Fayette: dry soil under cliffs, near Nuttallburg—L. W. N.

C. Jamesii, Schwein.
Fayette: open woods near Nuttallburg—L. W. N.

C. polytrichoides, Muhl.
Fayette: sphagnum swamp near Nuttallburg—L. W. N.

C. Fraseri, And. Frazer's Sedge.
The following remarks of Prof. T. C. Porter render it evident that this rare and odd sedge came originally from Randolph or Barbour county, each of which lies between the headwaters of the two Kanawhas:

"Muhlenberg, in his *Descriptio uberior Graminum*, etc., p. 265, under C. lagopus ?, which is C. Fraseri, Andrews, adds these words, 'Habitat in Tyger-Valley, Pennsylvaniae, *unde siccam habeo et vivam.*' Kin, the German gardner who collected in Pennsylvania, brought it home, and his label reads thus: 'Deigher Walli in der Wilternus.' Dr. Gray has shrewdly conjectured that by 'Deigher Walli,' or Tygert Valley, is meant Tygart's Valley, which lies further south in Virginia." In a foot-note, Prof. Porter adds "a box containing the Carices of Muhlenberg has just been discovered (1877) in the herbarium of the Academy, Philadelphia, and the label attached to the specimens of Kin's collection places Tyger Valley 'prope amnem Kenahway.' "

As the two Kanawhas lie entirely within the State of West Virginia, there seems to be little doubt as to the propriety of including this species in this Flora.

Since writing the above Mr. Nuttall has found a plentiful station for this species near Nuttallburg in the Great Kanawha region.

C. stipata, Muhl.
Ohio: near Wheeling—M. & G. Fayette: near Nuttallburg—L. W. N. Mercer: near Bluefield.

C. vulpinoidea, Michx.
Monongalia: along Falling Run. Wirt: near Burning Spring. Fayette: near Nuttallburg—L. W. N.

C. rosea, Schk.

Fayette: R. R. bank near Nuttallburg—L. W. N.

Var. **radiata**, Dewey.

Open places. Monongalia: near Round Bottoms. Wirt: along Straight Creek. Randolph: on Point Mountain, alt. 3450 feet; also on a dry rock, alt. 3650 ft. Fayette: cliffs, rocks and banks, near Nuttallburg—L. W. N.

Var. **retroflexa**, Torr.

Fayette: Swampy place near Nuttallburg—L. W. N.

C. sparganioides, Muhl.

Fayette: Wet open banks near Nuttallburg—L. W. N.

C. Muhlenbergii, Schk., *var.* ———

An intermediate between the type and variety *enervis*, *fide* Bailey. Randolph: on an undrained meadow along Tygart's Valley River, near Cricard.

Var. **enervis**, Boott.

Opens. Lewis: along Leading Creek.

C. cephalophora, Muhl.

Fayette: banks near Nuttallburg—L. W. N.

C. canescens, L., *var.* **vulgaris**, Bailey.

On a dry conglomerate rock. Randolph: summit of Rich Mountain, alt. 2850 feet.

C. tribuloides, Wahl.

In a springy rill. Wood: near Kanawha Station.

Var. **turbata**, Bailey.

Fayette: low copse near Nuttallburg—L. W. N.

C. scoparia, Schk.

Open swales. Monongalia: along Falling Run. Fayette: banks of river and in sphagnum bog near Nuttallburg—L. W. N.; dry glade, Alderson Farm—L. W. N.

C. straminea, Wild.

Dry soils. Fayette: near Nuttallburg—L. W. N.

GRAMINEÆ.

All doubtful forms have been kindly identified by Dr. Geo. Vasey.

SPARTINA, Schreb.

S. cynosuroides, Willd. Fresh-water Cord-grass.
Ohio: on Bogg's Island—M. & G. Fayette: near Nuttallburg—L. W. N.

PASPALUM, L.

P. setaceum, Michx.
Sandy soils. Monongalia: at the end of the Hog Back, Decker's Creek near Morgantown.

Var. **ciliatifolium** (Michx.)
Fayette: near Nuttallburg—L. W. N.

P. læve, Michx.
Fayette: near Nuttallburg—L. W. N.

PANICUM, L.

P. SANGUINALE, L. Crab, or Crow-foot Gress. L. W. N.
Cultivated and waste grounds. Common throughout the State.

forma **depauperata**, Vasey.
Dry sterile fields. Monongalia: up Falling Run beyond the campus.

P. proliferum, Lam. M. & G.
River banks. Monongalia: banks of the Monongahela, near Uffington and Morgantown. Fayette: near Nuttalburg—L. W. N.

Var. **geniculatum** (Ell.), Vasey. (P. *geniculatum*, Ell.)
Waste grounds. Monongalia: near Morgantown. Fayette: near Nuttallburg—L. W. N.

P. capillare, L. "Tickle Grass." M. & G.
Dry Fields. Monongalia: near Morgantown. Greenbrier: near White Sulphur Springs. Fayette: near Nuttallburg—L. W. N.

Var. **campestre**, Gattinger.
Dry fields. Monongalia: on a sterile hillside up Falling Run beyond the Campus.

P. anceps, Michx.
Fayette: near Nuttallburg—L. W. N.

P. agrostoides, Muhl.

Wet meadows. Kanawha: near Allen's Fork. Monongalia: below the mouth of Falling Run. Upshur: in a damp meadow near Lorentz. Fayette: near Nuttallburg—L. W. N.

P. virgatum, L.

Moist sandy soil. Monongalia: streets of Morgantown, growing between the bricks of walks, and seeming to flourish in direct proportion to the amount it is trodden upon. Mason: banks of the Ohio River near Point Pleasant. Fayette: near Nuttallburg—L. W. N.

P. latifolium, L.

Moist thickets. Wirt: near Burning Springs. Greenbrier: near White Sulphur Springs. Monongalia: near Little Falls. Fayette: near Nuttallburg—L. W. N.

P. clandestinum, L. "Deer-tongue Grass."

Damp meadows. Monongalia: common throughout. Upshur: near School House Summit. Summers: near Riffe. Monroe: near Wolf Creek. Fayette: near Nuttallburg.

A very nutritious grass; especially enjoyed by horses. Our analysis gives it a nutrative ratio of 1:4.24.

P. depauperatum, Muhl.

Dry opens. Fayette: near Nuttallburg—L. W. N. Monongalia: at Roundbottoms.

P. dichotomum, L. L. W. N.

Common everywhere, throughout the State.

forma **commune**, Man.

Common, especially along river banks: Monongalia and Marion: along the Monongahela River. Fayette: near Nuttallburg.

forma **fasciculatum**, Man.

Drier situations. Monongalia and Marion: along the F. M. & P. R. R.

forma **gracile**, Man.

Wet bottoms, usually along runs. Wood: in a swampy ditch near Kanawha Station. Wirt: in a weedy ditch near Reedy Ripple; in a spring rill in rich woods near Straight Creek. Randolph: in a cold rill in deep woods, on Point Mountain, alt. 3,200 ft.

Var. **elatum**.

Monongalia: along the F. M. & P. R. R., below Little Falls, in a sandy ditch. Fayette: near Nuttallburg—L. W. N.

P. pubescens, Lam.

Damp places. Lewis: along Leading Creek.

P. Crus-galli, L. Barnyard Grass. L. W. N.

Ditches and waste grounds. Monongalia: near Morgantown. Greenbrier: near White Sulphur Springs. Summers: near Hinton. Fayette: near Nuttallburg.

Var. **hispidum**(Muhl.), Torr.

Ditches. Monongalia: along the F. M. & P. R. R., near Little Falls.

CHAMÆRAPHIS, R. Br. (1810).
(Setaria, Beauv. 1812.)

C. glauca(L.). Fox-tail Grass. L. W. N., M. & G.

Common throughout the State, especially in stubble fields.

C. viridis(L.). L. W. N., M. & G.

Roadsides and cultivated fields. Jackson: near Sandyville, and on Limestone Ridge.

C. Italica(L.).

Fayette: near Nuttallburg—L. W. N.

CENCHRUS, L.

C. tribuloides, L. Hedgehog Grass. Bur-grass.

Jefferson: near Harper's Ferry—M. & G.

HOMALOCENCHRUS, Mieg (1768.)
(Leersia, Swartz. 1788.)

H. Virginica(Willd.), Britt. White Grass. (*Leersia Virginica*, Willd.)

Wet places. Monongalia: near Beechwoods and Little Falls. Fayette: near Nuttallburg—L. W. N.

H. oryzoides(L.), Poll. Rice Cut-grass. (*Leersia oryzoides*, Swartz.)

Wet grounds. Nicholas: in Collett's Glade. Fayette: near Nuttallburg—L. W. N.

TRIPSACUM, L.

T. dactyloides, L.

Moist places. Fayette: near Nuttallburg—L. W. N,

ANDROPOGON, Royen.

A. provincialis, Lam. Beard Grass. (*A. furcatus*, Muhl.)

Damp places. Randolph: along Tygart's Valley River near Beverly. Monongalia: along the Monongahela below Morgantown. Fayette: near Kanawha Falls—James; near Nuttallburg—L. W. N. Summers: near Greenbrier Stockyards; and along Greenbrier River. Taylor: near Grafton.

A. scoparius, Michx. "Broom Sedge."

Dry soils. Monongalia: about Morgantown, plentiful. Webster: near Upper Glade. Mason: near Point Pleasant. Taylor: near Grafton, and in every county visited.

This species, which threatens to be our most pernicious and wide-spread weed, is advancing eastward with the utmost aggressiveness. It has absolutely no fodder qualities, its nutritive ratio being only 1 : 14.50, and its value as a fertilizer only $2.37 per dry ton. The method of combatting this pest is as yet a mere matter of conjecture.

The plant is reported from Brooke: near Wellsburg and Fowler's. Barbour: near Overfield, Pepper and Philippi. Braxton: near Bulltown, Frametown, Tate Creek, Elmyra and Newville. Cabell: near Union Ridge and Barboursville. Clay: near Valley Fork. Doddridge: near Leopold, New Milton and Center Point. Fayette: near Fayetteville, Mountain Cove and Beets. Grant: near Medley, Petersburg and Greenland. Greenbrier: near Frankford, Trout Valley and Fort Spring. Hampshire: near Slanesville, Springfield and Three Churches. Harrison: near Clarksburg, Lost Creek, Bridgeport, Wallace, Wilsonburg, Adamsville, Good Hope and Mount Clare. Hardy: near Moorefield and Wardensville. Jefferson: near Kabletown. Jackson: near Grass Lick, Sandy, Wilding, Belgrove Odaville, Silverton and Kentuck. Kanawha: near Pocataligo, Blandon and Gazil. Lewis: near Vadis, Camden, Walkersville and Aberdeen. Lincoln: near Hamlin. Mercer: near Princeton and New Hope. McDowell: near Squire Jim. Monroe: near Cashmere and Johnson's X Roads. Mason: near New Haven, Grimm's Landing and Maggie. Marion: near Canton, Farmington, Eldora, Barracksville, Hoult and Gray's Flat. Monongalia: near Morgantown. Putnam: near Hurricane, Paradise, Carpenters and Confidence. Pleasants: near New Hebron. Preston: near Masontown, Eglon and Amblersburg. Ritchie: near Ritchie C. H. Berea and Cornwallis. Randolph: near Florence and

Lee Bell. Roane: near Pencil, Newton, Looneyville, Clio, Reedy and Countsville. Raleigh: near Table Rock, Egeria and Raleigh C. H. Summers: near Forest Hill, Talcott, Clayton and Indian Mills, Taylor: near Knottsville, Thornton, Grafton and Meadland. Tyler: near Wick and Long Reach. Tucker: near Texas, St. Georges and Hendricks. Upshur: near Lawrence, Overhill, Evergreen, French Creek and Hemlock. Wayne: near Adkin's Mills and Egypt. Wetzel: near New Martinsville. Wirt: near Elizabeth, Burning Springs, Reedy Ripple aud Lee. Wood: near Blennerhassett and Kanawha Station. Webster: near Replete, and Welch Glade.

A. **Virginicus**, L.
Fayette: near Nuttallburg—L. W. N.

CHRYSOPOGON, Trin.

C. **nutans**(L.), Benth. Indian Grass. Wood Grass.
Fayette: near Nuttallburg—L. W. N.

PHLARIS, L.

P. **arundinacea**, L. Reed Canary-grass.
Wet places. Wood. in a spring rill near Kanawha Station.

ARISTIDA, L.

A. **dichotoma**, L. Poverty Grass.
Fayette: near Nuttallburg—L. W. N.

A. **oligantha**, Michx. Triple-awned Grass.
Dry banks. Kanawha: near Charleston—Barnes.

A. **lanata**, Poir.
Fayette: near Nuttallburg—L. W. N.

MUHLENBERGIA, Schreber.

M. **sobolifera**(Muhl.). Trin.
Fayette: near Nuttallburg—L. W. N.

M. **Mexicana**(L.), Trin.
Fayette: near Nuttallburg—L. W. N. Monongalia: on campus, Morgantown.

M **sylvatica**(Torr.), Torr. & Gray.
Fayette: near Nuttallburg—L. W. N.

M. diffusa, Schreb. Nimble Will.
Dry ground. Monongalia: along Decker's Creek. Fayette: Nuttallburg—L. W. N.

BRACHYELYTRUM, Beauv.

B. aristosum(Michx.), B. S. P. (*B. aristatum*, Beauv.)
Rocky woods. Webster: near Welch Glade. Tucker: near the Falls of Blackwater. Fayette: near Nuttallburg—L. W. N.

Var. **glabratum**, Vasey, MSS.
A new variety discovered by Mr. L. W. Nuttall. It agrees with the species except that it is perfectly smooth, and has an awn pointed second glume which is about one-half the length of the flowering glume. Its most striking peculiarity is that it has invariably two culms from each rootstock.
High, rocky woods. Fayette: near Nuttallburg, rare —L. W. N.

PHLEUM, L.

P. PRATENSE, L. Timothy. L. W. N., M. & G.
A common escape from cultivation throughout the State. Found even in the forests of the highest Alleghanies.

AGROSTIS, L.

A. ALBA, L. White Bent-grass.
Meadows and fields. A frequent escape in the western counties. Fayette: near Nuttallburg—L. W. N.

Var. **VULGARIS**(With.), Thurb. Red Top. L. W. N.
Meadows the fields. Common throughout the State.

Forma, **artistata.**
Damp meadowlands. Monongalia: along Falling Run

A. prennans(Walt.), Tuckerm. Thin Grass.
Damp, shady places. Randolph: along Cheat River in clearings. Monongalia: near Little Falls. Fayette: near Nuttallburg—L. W. N.

A. hiemalis(Walt.), B. S. P. Hair Grass. *A. scabra*, Willd.
Moist fields. Preston: near Terra Alta. Fayette: near Nuttallburg—L. W. N

CINNA, L.

C. arundinacea, L. Wood Reed-grass.

Wet places. Randolph: along Tygart's Valley River near Huttonsville. Fayette: near Nuttallburg—L. W. N.

ARRHENATHERUM, Beauv.

A. ELATIUS (L.), Mert. & Koch. Oat Grass. (A. *avenaceum*, Beauv.)

Fields and yards. Monongalia, abundant and becoming a nuisance.

The lower campus (half orchard) that yielded a good crop of Orchard-grass last season, was almost completely this species this year. Our analysis of this grass shows a nutritive ratio of only 1:8.13. Fayette: near Nuttallburg—L. W. N.

HOLCUS, L.

H. LANATUS, L. Velvet Grass. "Old White Top." "Feather Grass."

Frequent in damp meadows. Monongalia: along the F. M. & P. R. R. Upshur: near Laurentz. Randolph: along Tygart's Valley River. Grant: near Bayard. Nicholas: in Collett's Glade. Fayette: near Hawk's Nest, and Kanawha Falls—James; Nuttallburg—L. W. N.

DANTHONIA, DC.

D. spicata (L.), Beauv. Wild Oat-grass.

Dry soil. Monongalia: near Beechwoods and Little Falls. Randolph: on a dry boulder, summit of Point Mountain, alt. 3750 ft. Fayette: near Nuttallburg—L. W. N.

D. compressa, Austin.

Dry banks. Tucker: near the Falls of Blackwater. Fayette: near Nuttallburg—L. W. N.

ELEUSINE, Gærtn.

E. INDICA (L.), Gaertn. Dog's Tail or Wire Grass.

Yards and streets. Kanawha: near Cannellton. Monongalia: near Morgantown. Mason: near Point Pleasant. Berkeley: near Martinsburg. Fayette: near Nuttallburg—L. W. N.

E. ÆGYPTICA, Pers. Crab-grass. Yard-grass.

Yards and lawns. Monongalia; on the campus.

SIEGLINGIA, Bernh. (1800)
(Triodia, R. Br. 1810)

S. cuprea(Michx.) Tall Red Top.
Dry or sandy fields. Monongala: near Little Falls. Wood: near Selden. Fayette: near Nuttallburg—L. W. N.

EATONIA. Raf.

E. obtusata(Michx.), Gray.
Rich woods. Fayette: near Nuttallburg—L. W. N.

E. Pennsylvanica(Spreng), Gray.
Moist opens. Monongalia: near Beechwoods and in the campus.

ERAGROSTIS. Beauv.

E. hypnoides (Lam.), B. S. P. *E. reptans*, Nees.
Shores of rivers. Summers: along New River near Hinton. Wood: along the Ohio River near Parkersburg. Mason: near Point Pleasant. Ohio: near Wheeling—M. & G.

E. MINOR, Host. *E. poaoides*, Beauv.
Waste places. Mason: near Point Pleasant.

E. MAJOR, Host.
Fayette: near Nuttallburg—L. W. N.

E. PILOSA(L.), Beauv.
Jefferson: near Harper's Ferry—M. & G. Fayette: near Nuttallburg—L. W. N.

E. Purshii, Schrader.
Sterile or sandy soils. Monongalia: near Little Falls, and on the campus.

E, capillaris,(L.), Nees.
Fayette: near Nuttallburg—L. W. N.

E. Frankii, Meyer.
Shores of rivers. Summers: along New River near Hinton.

MELICA, L.

M. mutica, Walt.
Rich soil. Fayette: near Nuttallburg—L. W. N.

CORYCARPUS, Zea. (1806)
(Diarrhena, Beauv. 1812)

C. Americana(Beauv.) Kuentz.
Shaded river banks. Fayette: near Nuttallburg—L. W. N.

UNIOLA, L.

U. latifolia, Michx.
Shady places: Fayette: near Nuttallburg—L. W. N.

DACTYLIS, L.

D. GLOMERATA, L. Orchard Grass. L. W. N.
Fields and meadows. Common throughout, especially in shady places.

POA, L.

P. ANNUA, L. Low Spear-grass.
Ohio: near Wheeling—M. & G. Fayette: near Nuttallburg—L. W. N.

P. COMPRESSA, L. Wire Grass. L. W. N.
Sterile soil in crevices of rocks. Plentiful throughout the State.

Forma **depauperata**.
On rocks. Monongalia: along Falling Run, especially at the cascade.

P. pratensis, L. Blue Grass. L. W. N.
Dry soils and meadows. Common throughout the State, even in the higher Alleghanies.

P. TRIVALIS, L. Roughish Meadow-grass.
Moist meadows. Monongalia: along the Monongahela at Little Falls.

P. sylvestris, Gray.
Ohio: near Wheeling—M. & G.

P. alsodes, Gray.
Hillside woods. Monongalia: along Day Creek near Little Falls. Fayette: near Nuttallburg—L. W. N.

P. flexuosa, Muhl. (not Wahl.).
Tyler: near Long Reach.

P. brevifolia, Muhl.
Ohio: Woods Run near Wheeling—M. & G. Fayette: near Nuttallburg—L. W. N.

PANICULARIA, Fabr. (1763)
(Glyceria, R. Br. 1810.)

P. Canadensis(Michx.).
Woods. Fayette: near Nuttallburg—L. W. N.

P. elongata(Torr.). Manna Grass.
Wet woods. Webster: along the ridge of Buffalo Bull Mountain. Fayette: near Nuttallburg—L. W. N.

P. nervata(Willd.). Foul Meadow-grass. L. W. N.
Moist meadows. Common throughout.

forma. **major**.
Monongalia: sand bars in Monongahela River near Little Falls.

FESTUCA, L.

F. octoflora, Walt. (*F. tenella*, Willd.)
Dry open woods. Wirt: hills above Burning Springs.

F. ELATIOR, L. Meadow Fescue.
Fields. Monongalia: near Beechwoods. Fayette: near Kanawha River—James; near Nuttallburg—L. W. N.

F. pratensis, Huds.
Meadows. Wood: near Kanawha Station; and elsewhere frequent.

F. nutans, Spreng.
Rocky woods. Randolph: on dry boulder, summit of Rich Mountain. Webster: roadsides near Long Glade. Fayette: near Nuttallburg—L. W. N.

BROMUS, L.

B. MOLLIS, L. Soft Chess.
Wheat fields and waste grounds. Monongalia: on the campus.

B. SECALINUS, L. Cheat or Chess. L.W.N., M.&G.
Wheat fields and waste places. A too common nuisance.

B. RACEMOSUS, L. Upright Chess. L. W. N.
Fields common throughout the State.

B. ciliatus, L.

River banks. Wood: along the Little Kanawha River near Kanawha Station. Monongalia: along the Monongahela near Little Falls.

LOLIUM, L.

L. PERENNE, L. Darnel. Rye Grass. English Blue Grass.

Lawns, introduced with "Lawn Grass Seed". Monongalia: at Morgantown. Fayette: near Nuttallburg—L. W. N.

ELYMUS, L.

E. Virginicus L. Virginia Wild-rye.

River banks. Ohio: near Wheeling—M. & G. Mason: near Point Pleasant. Fayette: near Nuttallburg—L. W. N.

E. Canadensis. L., *var.* **glaucifolius**(Muhl.), Gray.

Dry banks and roadsides. Kanawha: along 8-Mile Creek Mason: near Point Pleasant. Fayette: near Nuttallburg—L. W. N.

E. striatus, Willd.

Rocky banks. Monongalia: along the Monongahela river below Morgantown.

Var. **villosus**, Gray.

Monongalia: banks of the Monongahela below Morgantown.

HYSTRIX, Moench. (1794.)
(Asprella, Willd. 1809.)

H. Hystrix(L.) Bottle-rush Grass. L. W. N.

Moist woodland banks. Scattering in Wood, Wirt, Calhoun, Gilmer, Lewis, Upshur, Monongalia, Randolph, Webster and Nicholas counties. Fayette: along the Gauley River; near Gauley Mountains; near Nuttallburg: near Kanawha Falls—James. Summers: near Hinton. Mason: near Point Pleasant. Harrison: near Lumberport.

GYMNOSPERMÆ.

CONIFERÆ.

THUJA, L.

T. occidentalis, L. Arbor Vitæ.
Dry, rocky hills. Mineral: on Knobby Mountains. Grant: near Petersburg.

JUNIPERUS, L.

J. communis, L. Juniper.
Dry sterile hills. Wood: near Kanawha Station. Mineral: on Knobby Mountains. Fayette: near Nuttallburg —L. W. N.

J. Virginiana, L. Red Cedar. Savin. M. & G.
Wood: near Lockhart's Run and Kanawha Station. Wirt: on Nigh-cut Hill. Fayette: near Crescent; Kanawha Falls—James: Nuttallburg—L. W. N. Mineral: on Knobby Mountains. Jefferson: along the Potomac. Mason: near Point Pleasant. Berkeley: near Martinsburg. Monongalia: near Morgantown. Mercer: near Ingleside. Jackson and Mason: along the Ohio River: Cabell: along the C. & O. R. R., from Huntington, to St. Albans in Kanawha county.

TAXUS, L.

T. baccata, L., *var.* **Canadensis** Willd.), Gray. "Creeping Hemlock." Yew.
Damp hillside woods. Marion: near the mouth of Buffalo Creek—K. D. Walker. Taylor: near Nuzums. Fayette: along Williams River.

PINUS, L.

P. strobus, L. White Pine.
Wood: near Leachtown. Wirt: near Burning Spring. Calhoun: near White Pine and Laurel Run. Pocahontas: near Sunset. Greenbrier: near Caldwell. Fayette: near Nuttallburg, probably introduced—L. W. N.

P. Taeda, L. Loblolly, or Old-field Pine.
Opens. Wood: near Kanawha Station. Mineral, Hampshire, and Hardy: along the table-lands.

P. rigida, Mill. Pitch Pine.

Kanawha: near Charleston—Barnes. Fayette: near Nuttallburg, alt. 2000 ft.—L. W. N. Greenbrier: near White Sulphur Springs. Mineral: on Knobby Mountains.

P. pungens, Michx. f. Table Mountain Pine. M. & G.

Dry rocky soils. Kanawha: near Charleston—Barnes. Mineral on Knobby Mountain. Pendleton: foot hills of Spruce Knob—A. D. Hopkins.

P. Virginiana, Mill. Scrub Pine. (*P. inops*, Ait.)

Sterile hills. Greenbrier: near Caldwell. Fayette: near Nuttallburg, a common second growth—L. W. N. Berkeley: near Martinsburg. Mercer: near Ingleside.

P. echinata, Mill. Yellow Pine. (*P. mitis*, Michx.)

Wood: near Leachtown. Randolph: near Valley Bend. Summers: near Hinton.

PICEA, Link.

P. Mariana(Mill.) B. S. P. Black Spruce. "Yew Pine." "White Spruce." "Spruce Pine." *Abies nigra*, Poir.

Magnificent forests in the following regions where it grows at elevations varying from from 2500 to 4000 ft.:

	Acres.
Randolph County on Elk and Gauley waters	15,000
Randolph County on Cheat waters	120,000
Randolph County on Mill Creek	5,000
Randolph County on Elk Mountain	500
Pocahontas County on Shaver's Fork of Cheat	20,000
Pocahontas County on the headwaters of Greenbrier River	100,000
Pocahontas County on Elk and Gauley headwaters	100,000
Tucker County on Cheat waters	50.000
Mineral County	25,000
Greenbrier County (by actual survey)	35,499
Total acreage	470.999

This estimate will probably fall under the actual amount.

Summers: along Greenbrier river near Talcott. Mercer: near Ingleside.

TSUGA, Carrier.

T. Canadensis(L.), Carr. Hemlock. Hemlock Spruce. *Abies Canadensis*, Michx. M. & G.

Rocky woods. Wirt: along Straight Creek. Calhoun: on Laurel Run. Nicholas: near Beaver Mills. Grant: near Bayard, abundant. Monroe: near Alderson. Preston: near Terra Alta. Fayette: near Nuttallburg, plentiful—L. W. N. Mercer: near Ingleside and Princeton. McDowell: near Elkhorn. Monongalia: near Uffington and Tibb's Run.

ABIES, Miller.

A. balsamea, Miller. "Blister Pine." Balm-of-Gilead Fir. Balsam Fir.
Mountain Swamps. Randolph: about two miles beyond Cheat Bridge along the Staunton Pike.

SELAGINELLEÆ.

SELAGINELLA, Beauv.

S. rupestris(L.), Spring.
Jefferson: near Harper's Ferry—M. & G.

LYCOPODIACEÆ.

LYCOPODIUM, L.

L. lucidulum, Michx. M. & G.
Cold, damp woods. Grant: near Bayard. Randolph: near Cheat Bridge. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg, alt. 2000 ft.—L. W. N. Tucker: near Davis.

L. annotium, L.
Cold woods. Randolph: plentiful along the west slope of Cheat Mountains near Cheat Bridge. Fayette: near Nuttallburg—L. W. N.

L. obscurum, L. Ground Pine. (*L. dendroideum*, Michx.) M.&G.
Deep, moist woods. With the last, plentiful.

L. clavatum, L. Club Moss.
Dry woods. Common throughout the State.

L. complanatum, L. Trailing Christmas Green. M. & G.
Deep coniferous woods. In the Alleghanies of Grant, Tucker, Randolph and Pocahontas counties. Fayette: near Nuttallburg—L. W. N.

OPHIOGLOSSACEÆ.

OPHIOGLOSSUM, L.

O. vulgatum, L. Adder's Tongue.
Wet meadows and woods. Gilmer: near Glenville—V. M.

BOTRYCHIUM, Sw.

B. ternatum(Thunb.), Sw. Moon-wort.
Dry woods. Monongalia, Marion, Preston: in Laurel hills. Grant: near Bayard. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg, glades, alt. 2000 ft.—L. W. N.

Var. **australe**(R. Br.), Eaton.
Grassy places. Monongalia: on the campus near Morgantown.

Var. **rutæfolium**, Man.
Rich opens. McDowell: near Elkhorn.

Var. **obliquum**(Muhl.), Milde.
Fayette: near Nuttallburg, dry opens, alt. 2000 ft.—L. W. N. Ohio: hills back of Wheeling—M. & G. Monongalia: on the campus near Morgantown.

Var **dissectum**(Spreng.), Milde.
Glades. Fayette: near Nuttallburg, alt. 2000 ft.—L. W. N. Monongalia: on the campus near Morgantown.

B. Virginianum(L.), Sw. "Indicator." M. & G.
Rich woods. Grant: near Bayard. Randolph: on Rich Mountains.. Monongalia: Cheat river near Camp Eden. Gilmer: near Glenville. Jackson: near Ripley, where it is often called "Indicator" as its growth is thought to indicate the presence of Ginseng in the locality.

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PTERIDOPHYTA.

FILICES.

POLYPODIUM, L.

P. vulgare, L. Common Polypody. M. & G.
Common on mossy rocks and in rocky woods. Kanawha: near Charleston—Barnes; near Coalburg—James. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg L. W. N. Grant: near Bayard and along Buffalo Creek. Monongalia: along Cheat River. Tucker: along Beaver Creek and Blackwater. Randolph: on Rich and Cheat Mountains. Greenbrier: near White Sulphur Springs. Summers: near Hinton. McDowell: near Elkhorn.

Forma **biserrata,** mihi.
A form found upon mossy boulders along the Blackwater Fork of Cheat; with regularly doubly-serrate divisions of the thinish fronds.

P. incanum, Sw.
Rocks and tree trunks. Fayette: near Hawk's Nest—Porter.

CHEILANTHES, Sw.

C. vestita(Spreng.), Sw. Lip Fern.
Rocky places. Jefferson: near Harper's Ferry—M. & G.

C. lanuginosa, Nutt. Wooly Lip-fern.
Cliffs. Fayette: near Kanawha Falls—James.

PELLÆA, Link.

P. atropurpurea(L.), Link. Cliff Brake. M. & G.
Dry rocks. Fayette: near Nuttallburg, rare—L. W. N. Mercer: near Beaver Spring on exposed ledges, plentiful.

PTERIS, L.

P. aquilina, L. Brake or Bracken. M. & G.
Thickets and hillsides. Common throughout. Upshur: at School-house Summit. Webster: in Upper Glade.

Kanawha: near Coalburg and Charleston—James. Fayette: near Nuttallburg—L. W. N.

ADIANTUM, L.

E. pedatum, L. Maiden Hair Fern. L. W. N., V. M., M. & G.
Rich moist woods. Common throughout the State.

ASPLENIUM, L.

A. pinnatifidum(Muhl), Nutt. Spleenwort.
Cliffs and rocks. Jefferson: near Harper's Ferry—M. & G. Fayette: near Nuttallburg, in clefts of boulders, rare—L. W. N.

A. Trichomanes, L. M. & G.
Shaded cliffs. Wirt: near Burning Springs. Nicholas: along Peter Creek. Fayette: near Nuttallburg—L. W. N.; and along the Gauley River. Kanawha: near Coalburg—James. Gilmer: near Glenville. Greenbrier: near White Sulphur Springs.

A. platyneuron(L.), Oakes. (*A. ebenum.* Ait.)
Frequent in rocky open woods. Kanawha: near Charleston—Barnes. Fayette: near Nuttallburg—L. W. N. Wirt: near Burning Springs.

A. montanum. Willd.
Cliffs and rocks. Fayette: near Hawk's Nest—Porter (see Meehan's Monthly, Aug. 1892, plate); near Nuttallburg, alt. 2000 ft.—L. W. N. Jefferson: near Harper's Ferry—M. & G. Randolph: near Helvetia—M. & G. Grant: near Bayard. Monongalia: on boulders along Tibb's Run, plentiful.

A. angustifolium. Michx.
Rich woods. Ohio: near Wheeling—M. & G. Fayette: near Nuttallburg—L. W. N.

A. acrostichoides, Sw. (*A. thelypteroides.* Michx.)
Rich woods. Kanawha: near Charleston—James. Fayette: near Nuttallburg—L. W. N. Jefferson: near Harper's Ferry—M. & G.

A. Filix-fœmina(L.), Bernh.
Moist woods. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg—L. W. N. Ohio: near Wheeling—M. & G. Tucker: near the Falls of Blackwater.

CAMPTOSORUS, Link.

C. **rhizophyllus**(L.), Link. Walking Fern. Walking Leaf.
Shaded rocks and conglomerate boulders. Wirt: near Burning Springs. Fayette: along the Gauley River; near Kanawha Falls—James. Tucker: at Blackwater Falls. Gilmer: near Glenville—V. M. Kanawha: near Coalburg—James. Fayette: near Nuttallburg—L. W. N. Monongalia: near Morgantown:

PHEGOPTERIS, Fee.

P. **connectilis**(Michx.) B. S. P. Beech Fern. *P. polypodioides*, Fee.
Damp woods. Gilmer: near Glenville—V. M. Tucker: near the Falls of Blackwater.

P. **hexagonoptera**(L.), Fee.
Open woods. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg, shaded fence rows and deep woods—L. W. N. Ohio: near Wheeling—M. & G.

P. **Dryopteris**(L.), Fee.
Rocky woods. Preston: near Rowlesburg—M. & G.

ASPIDIUM, Sw.

A. **Thelypteris**(L.), Sw. Shield-fern.
Marshy Meadows. Ohio: near Wheeling—M. & G.

A. **Noveboracense**(L.), Sw. New York Shield Fern. M. & G.
Moist woods. Randolph: on Rich Mountain, alt. 1850 feet. Fayette: near Nuttallburg—L. W. N.; near Kanawha Falls—James. Kanawha: near Charleston—James.

A. **fragrans**, Swartz.
Opens. Pocahontas: near summit of Spruce Knob, alt: 4800 ft., where it is cut and cured for fodder.

A. **spinulosum**, Sw. Wood-fern.
Damp woods. Wirt: above Burning Springs. Randolph: on Rich Mountain. Fayette: near Nuttallburg—L. W. N. Preston: near Terra Alta. McDowell: near Elkhorn.

Var. ——
In deep, wet woods under Black Spruce. Randolph: near Cheat Bridge, and Shades-of-Death.

Var. **intermedium**(Willd.), Eaton. Common Wood-fern.
Deep rich woods throughout Grant, Tucker, Randolph and Pocahontas Counties. Upshur: near Beech and Middle Fork. Fayette: near Nuttallburg—L. W. N.

Var. **dilatatum**(Sw.), Hook.
Deep woods. Ohio: near Wheeling—M. & G.

A. cristatum(L.) Sw.
Swampy places. Preston: near Cranberry Summit—M. & G.; near Reedsville and Terra Alta.

A. Goldianum, Hook.
Rich moist woods. Preston: near Cranberry Summit—M. & G. Fayette: near Nuttallburg—L. W. N.

A. Filix-mas(L.) Sw. Male-fern.
Rocky woods. Gilmer: near Glenville—V. M.

A. marginale(L.) Sw. M. & G.
Rocky hillsides in rich woods. Gilmer: near Glenville—V. M. Kanawha: near Charleston—James. Fayette: near Nuttallburg—L. W. N. Grant: near Bayard.

A. acrostichoides(Michx.). Sw. Christmas Fern.
Rocky woods. Upshur: beyond Buckhannon. Randolph: near Cricard. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg—L. W. N.

Var. **Schweinitzii**,(Beck.), B. S. P. *Var. incisum*, Gray.
Rocky woods. Jefferson: near Harper's Ferry—M. & G.

CYSTOPTERIS. Bernh.

C. bulbifera(L.), Bernh. Bladder-fern.
Shaded ravines. Ohio: near Wheeling—M. & G. Fayette: near Nuttallburg, rare—L. W. N.

C. fragilis(L.), Bernh. M. & G.
Shady cliffs. Fayette: near Gauley Bridge along the Kanawha; near Nuttallburg—L. W. N.

ONOCLEA. L.

O. sensibilis, L. Sensitive Fern. M. & G.
Moist meadows. Monongalia: the Flats. Gilmer: near Glenville—V. M. Fayette—near Kanawha Falls—James; near Nuttallburg—L. W. N. Randolph: near Valley Head. Upshur: near Buckhannon.

WOODSIA, R. Br.

W. obtusa(Spreng.), Torr M. & G.
Rocks and cliffs. Fayette: near Nuttallburg—L. W. N. Randolph: near Cricard.

DICKSONIA, L'Her.

D. punctilobula(Michx.), Gray. Dickson's Fern. *D. pilosiuscula*, Willd.

Moist shady places. Randolph: on Rich Mountains, alt. 1920 ft. Cheat mountains under Black Spruce, abundant. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg, alt. 2400 ft.—L. W. N.; near Kanawha Falls and Loup Creek—James. Kanawha: near Charleston—James.

OSMUNDA, L.

O. regalis, L. Royal Fern. M. & G.

Swampy meadows. Upshur: near Randolph county line on Staunton Pike. Webster: Upper Glade. Gilmer: near Glenville—V. M. Fayette: near Nuttallburg—L. W. N. Preston: near Terra Alta and Cold Spring. Monongalia: near Camp Eden. McDowell: near Elkhorn.

O. Claytoniana, L. Clayton's Flowering Fern.

Low grounds. Preston: near Cranberry Summit—M. & G. Fayette: near Nuttallburg—L. W. N.

O. cinnamomea, L. Cinnamon Fern.

Marshy places. Fayette: near Nuttallburg, alt. 2000 ft.—L. W. N. Preston: near Cranberry Summit—M. & G. Randolph: along Shaver's Fork.

EQUISETACEÆ.

EQUISETUM, L.

E. arvense, L. Field Horsetail. L. W. N., M. & G.

Moist, sandy fields. Frequent throughout the State.

E sylvaticum, L.

Damp rich woods. Mercer: near Ada. Monongalia: near Little Falls.

E. hyemale, L. Scouring Rush.

Wet wooded banks. Wirt: near Burning Springs.

E. lævigatum, Braun.

Clay banks along stream. Mercer: near Ingleside.

BRYOPHYTA.

SPHAGNA.

SPHAGNUM, L.

S. cymbifolium, Ehrh.
Common in wet glades, and in deep wooded rills. Preston: Kingwood and Terra Alta. Monongalia: along Tibb's Run. Webster: at Welsh, Long and Collett's Glades. Fayette: glade above Nuttallburg. Randolph: in the Spruce forests.

MUSCI.

(All the species in this class have passed through the hands of Mrs. E. G. Britton, who has kindly determined them for this Flora.)

POLYTRICHACEÆ.

POLYTRICHUM, L.

P. commune, L.
Preston: on ground in open woods, Terra Alta.

P. Ohioense, Ren. & Card. *P. formosum, Sull.* not Hedw.
Monongalia: on ground, Morgantown (1536); a large form on ground Tibb's Run (1600); an extremely small form, with minute capsules on sandstone boulder, loc. cit. (1611). Mercer: on ground in oak woods, Bluefield (1453). Grant: on decayed logs, Bayard. Fayette: near Nuttallburg—L. W. N.

P. piliferum, Schreb.
Monongalia: on bare sandstone ledge, Falling Run, (1299.)

P. tenue, Menz. *Pogonatum brevicaule*, Beauv.
Monongalia: roadside banks, Morgantown; on ground, Tibb's Run (1612). Fayette: near Nuttallburg—L. W. N.

CATHARINEA, Ehrh.

C. angustata, Brid. *Atrichum angustatum*, Br. & Sch.
Monongalia: on ground in marshy spot, Morgantown

(1406). Mercer; rocks in rill, Beaver Spring (1495) Fayette: near Nuttallburg—L. W. N.

C. undulata (L.), Web. & Mohr. *Atrichum undulatum*, Beauv.
Monongalia: on ground in marshy spot, Morgantown (1404) McDowell: on roots in stream, Elkhorn (1522) Fayette: near Nuttallburg—L. W. N.

GEORGIACEÆ.

GEORGIA, Ehrh.

G. pellucida (L.), Rabenh. *Tetraphis pellucida*, Hedw.
Monongalia: on sandstone boulder, Tibb's Run (1606, 1610, 1634).

FISSIDENTACEÆ

FISSIDENS, Hedw.

F. adiantoides (L.), Hedw.
Monongalia: on shaly rocks under cliff, Cassville (1423).

F. decipiens, Schimp.
Fayette: near Nuttallburg—L. W. N.

MNIACEÆ.

ASTROPHYLLUM, Neck.

A sylvaticum, Lindb. *Mnium cuspidatum*, Hedw.
Monongalia: on soil, Morgantown (1359); on dry boulder, Cheat River (1397); on stone in swampy spot, Dille's (1583). Fayette: near Nuttallburg—L. W. N.

A rostratrum (Schrad.), Lindb.
Grant: on wet logs, Bayard. Monongalia: on decayed wood, The Flats (1377). McDowell: on roots in rill, Elkhorn (1523).

A. punctatum (L.) Lindb. *Mnium punctatum* (L.) Hedw.
Fayette: near Nuttallburg—L. W. N.

A. hornum (L.), Lindb.
Monongalia: on sand in rill, Tibb's Run (1604). Fayette: near Nuttallburg—L. W. N.

SPHÆROCEPHALUS, Neck.

S. heterostichus(Brid.), Britt.m. *Aulacomnion heterostichum*, Br. & Sch.

Monongalia: On coal entrance to coal pit, Georgetown (1379); hanging from sandstone boulder, Tibb's Run (1607), Camp Eden (1392); on rocky ledge, Cassville (1414). McDowell: on sandy bank of rill, Elkhorn (1520). Fayette: near Nuttallburg—L. W. N.

BARTRAMIACEÆ.

BARTRAMIA. Hedw.

B. pomiformis(L.), Hedw.

Mercer: on bole dead tree, Bluefield (1478). Monongalia: on sandstone boulder, deep woods, Tibb's Run (1609). Fayette: near Nuttallburg—L. W. N.

Var. **crispa**(Sw.), Schimp.

Monongalia: on rock ledge, Cassville (1417. 1418).

PHILONOTIS, Brid.

P. fontana(L.), Brid.

Mercer: on sandstone ledge in rill, Beaver Spring(1561)

BRYACEÆ.

BRYUM, L.

B. bimum, Schreb.

Monongalia: on shale under ledge, Cassville (1424.)

B. argenteum, L.

Monongalia: fissures between bricks of walks, Morgantown (1335). Fayette: near Nuttallburg—L. W. N.

B. proliferum(L.), Sibth. *B. roseum*, Schreb.

Mercer: on roots of oak, Bluefield (1449). McDowell: on decayed wood, Elkhorn (1502).

LEPTOBRYUM, Wils.

L. pyriforme(L.), Wils. *Bryum pyriforme*, Hedw.

Monongalia: on sandstone boulder, Tibb's Run (1616. 1633).

FUNARIACEÆ.

FUNARIA, Schreb.

F. hygrometica(L.), Sibth.
Monongalia: in soil on sandstone boulder, Tibb's Run (1615. 1617). Fayette: near Nuttallburg—L. W. N.

Var. **patula**, Br. & Sch.
Monongalia: on rocks lining a spring, the Flats (1376): in cinders of an old camp-fire, Camp Eden (1293).

F flavicans, Michx.
Monongalia: on damp sand in a "burning," Little Falls (1277): loc. cit., Morgantown(1339.)

PHYSCOMITRIUM, Brid.

P. pyriforme(L.), Brid.
Monongalia: on top of soil of field that had been ploughed and harrowed only eight days before, Morgantown (1278); on ground marshy spot, Dille's (1403).

TORTULACEÆ.

LEERSIA, Hedw.

L. streptocarpa(Hedw.), Lindb. *L. contorta*, Wolf. *Encalypta streptocarpa*, Hedw.
Mercer: face dry limestone cliff, Beaver Spring (1552).

TORTULA, L.

T. muralis (L.), Hedw. *Barbula muralis* (*L.*), Trin.
Mercer: on sandstone ledge, Beaver Spring (1553).

BARBULA, Hedw.

B. humilis, Hedw. *B. cæspitosa*, Schwægr.
Mercer: roots of oak, Bluefield (1447). Fayette: Nuttallburg—L. W. N.

B. tortuosa(L.), Web. & Mohr.
Monongalia: in sand under boulder, Camp Eden (1395).

MOLLIA, Schrank.

M. viridula(L.), Lindb. *Weisia viridula*, Hedw.
McDowell: on ground, open woods, Elkhorn (1496. 1497). Fayette: near Nuttallburg—L. W. N.

DICRANACEÆ.

LEUCOBRYUM, Hampe.

L. glaucum (L.), Schimp.

Monongalia: on ground in woods, The Flats (1399). Fayette: Nuttallburg—L. W. N.

DICRANODONTIUM, Br. & Sch.

D. Virginicus, Britt. m. Sp. nov.

Monongalia: on sandstone boulder along a woodland path, Tibb's Run (1635).

Plants bright glossy green, stems matted below by a red tomentum, leafy nearly to apex, denudate roughened above, with a few leaves at summit; leaves erect or secund, straight or curled and twisted, often 5 mm. long, narrowly subulate from a short, thick base, caducous ones with a long, slender, smooth point; persistent ones serrate, blade inflexed cells densely chlorophyllose, filled with oil globules, those of the basal angles, clear. Diœcious, the antheridia terminal in conspicuous heads, bracts brown at base, apex subulate, serrate; perichætial bracts 3–4mm. long, from a short base, suddenly subulate, dentate at apex; pedicels lateral by the growth of innovations, 1½–2cm. long, pale, glossy yellow, twisted in two directions, very slender, arcuate when young, becoming erect before capsules mature. Capsule cylindric, ribbed only at the mouth, 1½–2mm. long, beak straight or curved, shorter than the capsule, peristome bright red, *not deep set*, teeth split unequally to middle, striolate at base, pale and granulose above, annulus none, spores small, calyptra cucullate, 2mm. long, beaked, entire. Maturing in summer.

Differs from European specimens of *D. longirostre* collected by Seringe; in the longer, paler, more slender, scarcely arcuate pedicels, longer capsules, peristome not deep set, and teeth split only to the middle, more united than figured in the Bryologia Europea, Table 88. It may be distinguished from *Campylopus Virginicus*, also remarkable for its caducous leaves, by the longer, more slender subulate point, which is entire or minutely serrate and smooth on the back, by the thick base, with inflexed blades, and by the shape of the basal cells at the angles.

D. Millspaughi, Britt. m. Sp. nov. *Campylopus flexuosus*, Sull. not Brid.

Monongalia: on sandstone boulder deep woods, Tibb's Run (1596).

Plant slight yellowish green, silky, cæspitose; stems matted with rufous tomentum at base, 1-3cm. long, a few

Dicranodontium Millspaughi, n. sp.

denudate, roughened by the fragments of the slightly caducous leaves. Leaves secund or erect-spreading, 4-5mm. long, narrowly subulate from a broad base 1-1½mm. long, becoming tubular above with inrolled margins, basal angles not auricled, filled by large hyaline cells to the base of the broad, brown vein, those of the blade oblong or square next the vein, becoming spindle-shaped and prosenchymatous toward the margin, vein thick, excurrent into a dentate slender tip, rough on back. Diœcious, perichætium 5-7mm. long, bracts sheathing half their length, tapering to a long, slender, obscurely serrate tip, outer shorter, abruptly subulate, more sharply serrate; pedicels recurved, burying the capsules among the leaves, becoming erect when old, 5-8mm. long, stout and twisted in two directions; capsules pyriform-cylindric with a distinct neck, length about 1mm. without the lid which is as long as the rest of the capsule, with a straight beak, calyptra cucullate, entire; peristome red, connivent, teeth deep set, slender, split to middle, or perforate to base, striolate below, granulose above; annulus none, mouth bordered by a dense, dark rim. Maturing in summer, old capsules persistent, not sulcate.

Differs from European specimens of *D. longirostre* in the structure of the base of the leaf, lacking the suddenly inflated basal auricles; differing also in the cells above the base, teeth not split to base, occasionally only perforate. From *D. Virginicus* it may be distinguished by the less caducous leaves, shorter, stouter, more arcuate pedicels, smaller capsules, and longer sheathing perichætium.

Through the kindness of Dr. Robinson I have been able to compare these specimens with those collected by Sullivant on Grandfather Mt. in 1843. His also are fruiting, and an excellent drawing is preserved, hence I am able to assert that the specimens are almost identical. Sullivant's showing no naked stems, but many of the leaves are caducous. Dr. Braithwaite kindly compared the West Virginia specimens with *Campylopus pyriformis* sending me specimens of this and the variety *Mulleri*, and sketches of the bases of the leaves. It is evident that Sullivant was mistaken in referring his specimens to *C. flexuosus*, as they are more closely allied to *Dicranodontium longirostre*, var. *alpinus*.

DICRANUM, Hedw.

D. flagellare. Hedw.

Monongalia: on decayed oak log, Tibb's Run (1593.) Fayette: Nuttallburg—L. W. N.

D. scoparium,(L.), Hedw.

Grant: on ground in damp woods, Bayard. Monongalia: on ground, the Flats (1398); on decayed log, George-

town (1382); loc. cit., Tibb's Run (1601). Mercer: in tuffts at base of stump, Bluefield (1476), and on decayed log (1464.) Fayette: near Nuttallburg—L. W. N.

D. fulvum, Hook.
Fayette: Nuttallburg—L. W. N.

DICRANELLA, Schimp.

D. heteromalla(L.). Schimp.
Monongalia: on ground under rail fence, The Flats (1362); on wet coal entrance of coal pit, Georgetown (1378); on ground in woods, Tibb's Run (1638). Fayette: Nuttallburg—L. W. N.

DITRICHUM, TIMM.
(Lepotrichum, Hampe.)

D. pallidum(Schreb.), Hampe. *Trichostomum pallidum*, Hedw.
Mercer: on ground oak woods, Bluefield (1458). McDowell: on clay open woods, Elkhorn (1492. 1495. 1500.) Monongalia: on clay of open woods, Tibb's Run (1598). Fayette: near Nuttallburg—L. W. N.

CERATODON, Brid.

C. purpureus(L.) Brid.
Monongalia: on dry sandstone boulder, Morgantown (1390).; loc. cit., Tibb's Run (1633). Fayette: near Nuttallburg - L. W. N.

GRIMMIACEÆ.

WEISSIA, Ehrh.

W. Americana(Palis)., Lindb. *Ulota Hutchinsiæ*, Schimp.
Monongalia: on dry sandstone boulder, Camp Eden (1390). Fayette: Nuttallburg—L. W. N.

ORTHOTRICHUM, Hedw.

O. Braunii, Br. & Sch. *O. strangulatum*, Beauv.
Monongalia: on bark living apple tree, Morgantown (1288).

HYPNACEÆ.

THUIDIUM, Br. & Sch.

T. recognitum(Hedw.). Lindb. *T. delicatulum, Br. & Sch.*
Grant: on decayed logs. Bayard. Monongalia: on dry boulder, The Flats (1366); Tibb's Run (1608); on de-

cayed logs, Georgetown (1382). Mercer: on sandstone ledge, Beaver Springs (1544); on bole dead tree (1477); loc. cit., Bluefield (1510). Fayette: near Nuttallburg—L. W. N.

ANOMODON, Hook. & Tayl.

A. rostratus(Hedw.), Schimp.

Monongalia: on dry boulder, The Flats (1365); loc. cit., Camp Eden (1391). Mercer: on sandstone ledge in rill, Beaver Spring (1555); on bole living oak, Bluefield (1456. 1536). Fayette: Nuttallburg—L. W. N.

A. attenuatus(Schreb.), Huebn.

Monongalia: on dry boulder, The Flats (1363. 1367). Mercer: completely covering large limestone ledges in open woods, Beaver Spring (1531).

AMBLYSTEGIUM, Br. & Sch.

A. adnatum, Hedw.

McDowell: on flat stone in deep woods, Elkhorn (1498).

A. serpens(L.), Br. & Sch.

Monongalia: on wet rotten long, Granville (1298); on twigs in rill, Dille's (1402). McDowell: on pebble in deep woods, Elkhorn (1519).

Var. **orthocladon**(Beauv.), Aust.

Monongalia: on rocks lining a spring, The Flats (1375). Mercer: on wet limestone ledge, Beaver Spring (1358).

A. varium(Hedw.), Lindb. *A. radicale*, Br. & Sch.

Monongalia: on rocks lining a spring, The Flats (1374); on wet rocks in stream, Cassville (1421). Mercer: on limestone ridge, Beaver Spring (1533); on decayed log, Bluefield (1488. 1536). McDowell: on top of stump in dark, deep woods, Elkhorn (1521).

A. irriguum(Hook. & Wils.), Br. & Sch.

Mercer: on sandstone ledge in rill, Beaver Spring (1556. 1559). Monongalia: on rocks in rill, Tibb's Run(1592).

A. riparium(L.), Br. & Sch.

Monongalia: on stone in stream, Falling Run (1334) McDowell: loc., cit., Elkhorn (1512).

A. chrysophyllum(Brid.), De Not. *Hypnum chrysophyllum*, Brid.

Monongalia: on old beech log, Morgantown (1405); Mercer: on ground, Beaver Spring (1536.)

HYPNUM, L.

H. denticulatum, L.

Monongalia: on walls of dark dripping limestone

cave, Cheat river: on stone in swampy place, Morgantown (1405); on sandstone boulder, and on pebbles in stream, Tibb's Run (1614.)

H. palustre, ?

Monongalia: on stone in marshy spot, Morgantown (1584); on rocks under a fall, Casville (1422.)

H. molle, Dicks.

Monongalia: on stone in marshy place, Dille's (1584.)

H. proliferum, L. *H. splendens*, Hedw.

Randolph: in dense spruce forests, where it carpets almost everything beneath the trees, Cheat Bridge. Grant: notul. idem., Bayard.

H. rutabulum, L

Monongalia: on rocks in rill, Tibb's Run (1591).

H. recurvans, Schwaegr.

Tucker: on decayed logs, etc., Blackwater Falls (990-2). McDowell: loc. cit., Elkhorn (1499. 1507). Monongalia: on bole of tree, Tibb's Run (1597).

H. microcarpum, C. Muell.

Monongalia: on bark of hemlock tree, Cheat River (1389).

H. hians, Hedw.

Mercer: on damp, decayed bark, Bluefield (1840).

H. demissum, Wils. *Rhynchostegium demissum*, Br. & Sch.

Monongalia: on stones in rill, Tibb's Run (1619); and on wet rocks (1595).

BRACHYTHECIUM, Schimp.

B. salebrosum, Br. & Sch. *Hypnum plumosum*, Huds.; *H. salebrosum*, Hoffm.

Fayette: near Nuttallburg—L. W. N.

STEREODONTACEÆ.

THELIA, Sull,

T. hirtella(Hedw.), Sull.

McDowell: on bark living beech, Elkhorn (1493.)

T. asprella(Schim.), Sull.

Mercer: on bole living Cornus florida, Beaver Spring (1535.)

HYLOCOMIUM, Br., & Sch.

H. parietinum(L), Lindb. *Hypnum Schreberi*, Willd.

Monongalia: on ground shade of Hemlocks, Laurel Hills (1645.)

H. triquetrum(L.), Br. & Sch.
Monongalia: on ground shade of hemlocks, Laurel Hills (1649.)

CAMPYLIUM. Mitt.

C. hispidulum(Brid.), Mitt. *Hypnum hispidulum*, Brid.
Mercer: on ground, oak woods, Bluefield (1452).

C. chrysophyllum.
Mercer: on decayed log, damp place, Bluefield (1490, 1491).

Var. **tenellus.**
Mercer: on bole dead tree, Bluefield (1479); on log damp place (1486).

PTILIUM. De Not.

P. crista-castrense(L.), De Not. *Hypnum crista-castrense*, L.
Plentiful on ground, rocks, logs, etc., in the dense spruce forests. Grant: near Bayard. Randolph: near Cheat Bridge.

STEREODON. Mitt.

S. imponens(Hedw.), Brid. *Hypnum imponens*, Hedw.
Monongalia: on decayed log, Georgetown (1381); loc. cit., Tibb's Run (1582). Fayette: near Nuttallburg—L. W. N.

S. cupressiforme(L.), Brid. *H. cupressiforme*, L.
Mercer: on damp decayed log, Bluefield (1487).

S. curvifolius(Hedw.), Brid. *H. curvifolium*, Hedw.
Monongalia: on decayed oak, Little Falls (1276); near Morgantown (1344); near Georgetown (1380); near Cassville (1420); on ground, Georgetown (1382). McDowell: on decayed log, Elkhorn (1517). Mercer: loc. cit., Bluefield (1485), and Beaver Spring (1491). Fayette: near Nuttallburg—L. W. N.

PYLAISIA, Br. & Sch.

P. velutina, Br. & Sch.
Monongalia: on bark living apple tree, Morgantown (1289.)

PLAGIOTHECIUM. Br. & Sch.

P. denticulatum, Br. & Sch.
Fayette: near Nuttallburg—L. W. N.

P. deticulatum, *var.* **densum.**
Monongalia: on sandstone boulder, Tibb's Run (1642.)

P. Sullivantiæ, Schimp.

Monongalia: on sandstone boulder in deep woods, Tibb's Run (1618.)

CYLINDROTHECIUM, Br. & Sch.

C. seductrix(Hedw.), Sull.

Monongalia: on bark living apple tree, Morgantown (1290). on bark in oak woods, Bluefield (1450). Fayette: near Nuttallburg—L. W. N.

C. cladorhizans(Hedw.), Schimp.

Mercer: on decayed log, damp place, Bluefield (1489). Fayette: near Nuttallburg—L. W. N.

ENTODON, C. Muell.

E. palatinus(Neck.), Lindb. *Platygyrium repens*, Br. & Sch.

Monongalia: on decayed log, Tibb's Run (1603). Fayette: near Nuttallburg—L. W. N.

NECKERACEÆ.

NECKERA, Hedw.

N. pennata(L.), Hedw.

Tucker: on tree trunks, Blackwater Falls (965).

CLIMACIUM, Web. & Mohr.

C. Americanum, Brid.

Monongalia: on moist sandstone ledge, Cassville(1413).

LEUCODON, Schwaeger.

L. julaceus(Hedw.), Sull.

Mercer: on limestone ledge, Beaver Springs (1532); McDowell: on rocks in rill, Elkhorn (1508). Monongalia: on oak log, Tibb's run (1590).

L. brachypus, Brid.

Grant: on wet rotten log, Bayard (937).

HEDWIGIA Ehrh.

H. ciliata, Ehrh.

Monongalia: on dry, exposed boulders and rocks, The Flats (1400).

HEPATICÆ.

(The following species are arranged in accordance with Dr. A. W. Evans' "Arrangement of the Genera of Hepaticæ;" Dr. Evans has kindly looked over and identified all the numbers here reported.—C. F. M.

JUNGERMANNIACEÆ.

FRULLANIA, Raddi.

F. Asa-Grayana, Mont.

Monongalia: on sandstone boulder, Tibb's Run (1654). Randolph: clinging to face of dry sandstone boulder, Pickens (2206).

JUBULA, Dumort.

J. Hutchinsiæ (Hook.) Dum. var. **Sullivantii**, Spruce.

McDowell: on rocks in stream, Elkhorn (1509). Monongalia: on sandstone boulder, Tibb's Run (1655).

LEJEUNEA, Libert.

L. clypeata (Schw.) Sull.

Monongalia: on sandstone boulder, Tibb's Run (1656.)

RADULA, Nees.

R. Xalapensis, Mont.

Mercer: face of limestone cliff, Beaver Spring (1551.) Agrees with Hep. Am. 104. Rare.

R. tenax, Lindb.

Monongalia: on sandstone boulder in deep woods, Tibb's Run (1657.) Grant: on bark living cherry, deep woods, Bayard (2060.)

PORELLA, Dill.

P. platyphylla (L.) Lindb.

Monongalia: on bark living apple tree, Morgantown (1291, 1292): on sandstone boulder, Tibb's Run (1658). Mercer: on oak log, Bluefield (1448): on limestone ledge, Beaver Spring (1530)

P. pinnata, L.

Fayette: on rocks in mist of falls, near Gauley Bridge (607).

TRICHOCOLEA, Dumort.

T. tomentella (Ehrh.). Dum.

McDowell: growing with Catharinea undulata on roots in rill, Elkhorn (1522 pt.). Grant: on wet sand in deep ravine, Bayard (2040).

HERBERTA, S. F. Gray.

H. adunca(Dicks.) S. F. G.

Monongalia: on sandstone boulder in deep woods, Tibb's Run, (1659.)

Other U. S. stations for this species are: Virginia, White Top Mt.—Mrs. Britton. North Carolina—Mr. Small. New York, Caatskills—Austin; New Jersey, Greenwood Mts.—Austin.

BAZZANIA, S. F. Gray.

B. trilobata(L.), S. F. G. *Mastigobrium trilobatum*, Nees.

Monongalia: on bole of tree in deep woods, Tibb's Run (1639. 1640); in wet depression sandstone boulder, loc. cit. (1660). Fayette: in deep woods—L. W. N. Grant: on wet Hemlock log, Bayard (2010.)

B. deflexa(Mart.), Underw.

Monongalia: on sandstone boulder in deep woods, Tibb's run (1661.)

CEPHALOZIA, Dum.

C. multiflora, Spruce.

Monongalia: on sandstone boulder and on ground in deep woods, Tibb's run (1662). Grant: on wet Hemlock log, deep woods, Bayard (2080).

C. curvifolia(Dicks.), Dum.

Monongalia: with the last, on sandstone boulder deep woods, Tibb's run (1663.) Grant: on wet dead bark deep woods, Bayard (2021).

ODONTOCHISMA, Dum.

O Sphagni(Dicks.), Dum.

Monongalia: among mosses on sandstone boulder, deep woods, Tibb's Run(1664).

BLEPHAROSTOMA, Dum.

B. trichophyllum(L.), Dum.

Monongalia: on ground and sandstone boulder, deep woods, Tibb's Run (1665).

KANTIA, S. F. Gray.

K. Trichomanis(L.), S. F. G.

Tucker: on wet decayed logs, near Blackwater Falls

(993). Monongalia: on wet ground (1599), and on sandstone boulder in deep woods (1666), Tibb's Run. Randolph: on damp sand, Pickens (2207).

ANEURA, Dum.

A. multifida (L.), Dum.

Grant: on wet dead bark (3030), and wet decorticated wood (2070); in deep wooded ravine, Bayard.

GEOCALYX, Nees.

G. graveolens (Schrad.) Nees.

Monongalia: on ground and sandstone boulders, deep woods, Tibb's run (1667.)

SCAPANIA, Dum.

S. nemorosa(L.), Dum.

Monongalia: on damp sandstone boulder deep woods, Tibb's run (1668). Grant: on wet Hemlock log in deep woods, Bayard (2011). Randolph: on clay near a spring, Pickens, (2212).

DIPLOPHYLLUM. Dum.

D. taxifolium(Wahlenb.), Dum.

Monongalia: on sandstone boulder deep woods, Tibb's run (1669.)

PLAGIOCHILA, Dumort.

P. Virginica, Evans; sp. nov.

Growing in wide, depressed, and intricate tufts; stems ascending from a prostrate caudex, simple or sparingly branched, sometimes geniculate and rooting at the joints, otherwise eradiculose; leaves contiguous or somewhat imbricated, widely patent, ovate or rhomboid-ovate, the dorsal margin decurrent, slightly reflexed, entire, the ventral margin plane or reflexed at base, mostly entire, the apex broad, rounded or truncate, sharply and irregularly spinulose; amphigastria none

Stems 1 to 3 cm. long, with the leaves 1 to 2 mm. wide; leaves 1.2 mm. long, 0.7 mm. wide; spines short, acute, separated by rounded sinuses, varying in number from 2 to 3 on each leaf, usually 4 or 5; leaf-cells averaging 0.023 mm. in diameter in middle of leaf, thin-walled and scarcely thickened at the angles.

Mercer: on walls of dry limestone cave, Beaver Spring (1550).

Description of Figures.

Fig. 1. Plants, natural size.
" 2. Apex of stem, dorsal view x 11.
" 3. Part of stem, ventral view x 11.
" 4. Apical teeth of leaf x 115.
" 5. Cells from middle of leaf x 225.

P. porelloides (Torr.), Lindb.

Monongalia: on sandstone boulders in moss, Tibb's Run (1700). Grant on wet stones (2000, 2050), and in wet sand (2041), in deep ravine, Bayard.

JUNGERMANNIA, Michx.

J. exsecta, Schmid.

Grant: on wet hemlock log in deep wooded ravine, Bayard (2012).

PELLIA, Raddi.

P. epiphylla(L), Corda.

Randolph: on clay near a spring, Pickens (2211).

HARPANTHUS, Nees.

H. scutatus(Web. & Mohr.), Spruce.

Monongalia: on ground and sandstone boulder, deep woods, Tibb's Run (1670). Grant: on damp dead bark, Bayard (2020, 2031).

METZGERIA, Raddi.

M. conjugata, Lindb. *M. furcata*, Dum. in. pt.

McDowell: on bark of beech, Elkhorn (1513). Monongalia: on bark of twig (1671).

MARCHANTIACEÆ.

MARCHANTIA, L.

M polymorpha, L.

Randolph: on ground in burnt place, summit of Point Mt. alt. 3700 ft. Grant: similar situation, near Bayard. Tucker: loc. cit., near Blackwater Falls. Gilmer: near Glenville—V. M. Monongalia: among damp mosses base of sandstone boulder, Tibb's run; between bricks of sidewalk with Bryum argenteum, Morgantown.

CONOCEPHALUS, Necker.

C. conicus(L.), Dum.

Monongalia: on ground and sandstone boulders deep woods, Tibb's run (1672.)

A.W.E. del. ad nat.

Plagiochila Virginica, n. sp.

THALLOPHYTA.

LICHENES.

(The few specimens that I have gathered in this class, incidental to the collection of the higher orders, have been kindly examined by Dr. J. W. Eckfeldt.)

USNEÆ.

USNEA, Ach.

U barbata(L.), Fr.

Wirt: on old trees, common, Burning Springs. Randolph: on Rhododendron max. common, Cheat Bridge. Mercer: on oak twigs, Bluefield.; and elsewhere about State common on trees, rocks, and old fence rails.

Var. **florida**, Fr.

Mercer: on oak twigs and chips among dead leaves, Bluefield.

PARMELIEÆ

PARMELIA, Ach.

P. Borreri, *var.* **rudecta**, Tuck.

Monongalia: on bark living locust tree, Falling Run (1531).

P. caperata(L.), Ach.

Monongalia: on sandstone rocks and base of beech, Falling Run (1283).

P. olivacea(L.), Ach.

On Liriodendron log newly felled. Monongalia: Falling Run (1343).

PHYSCIA, DC.

P. lucomela(L.), Michx.

Mercer: with moss on wet limestone ledge, Beaver Spring (1539).

PELTIGERIEÆ.

STICTA, Schreb.

S. **pulmonaria**(L.), Ach.
Wirt: on trunks of oaks, near Burning Springs (327).

S. **herbacea**(Huds.), Ach.
McDowell: on oaks, Elkorn.

PELTIGERA, Willd.

P. **aphthosa**(K.), Hoffm.
Monongalia: on rock ledge, near Cassville.

LECANOREÆ.

PLACODIUM, DC.

P. **cerinum**(Hedw.), Naeg. & Hepp.
Monongalia: on bark of beech, Falling Run (1357).

LECANORA, Ach.

L. **astra**(Huds.), Ach.
Monongalia: on bark Liriodendron log, newly felled, Falling Run (1342); on flat exposed surface sandstone rock, same locality (1287).

CLADONIEÆ.

CLADONIA, Hoffm.

C. **Mitrula**, Tuck.
Monongalia: old beech log, Falling Run (1346).

C. **pyxidata**(L.), Fr.
Monongalia: along Falling Run, on bare sandstone rocks (1281); on moss in clay soil (1285); on decayed log (1338); base of beech in soil (1282).

C. **gracilis**(L.), Nyl.
Monongalia: along Falling Run, on decayed log (1337); among mysses on clay soil (1286).

C. **rangiferina**(L.), Hoffm.
Monongalia: on moss, Falling Run (1361).

C. furcata, *var.* **racemosa**, Floerk.

Monongalia: large patches on ground under chestnuts. Dille's. Mercer: same growth under oaks, near Beaver Spring.

C. cristatella, Tuck.

Monongalia: on an old decayed log, Falling Run (1336).

DIATOMACEÆ.

(Only one attempt has been made so far to collect species in this sub-class; this was a dredging in a small pasture pool near Morgantown. The result was kindly examined, and the species identified, by the Rev. Albert Monn, Jr.)

Cymbella gastroides, Kuetz.
turgida(Grun.), Greg.

Stauroneis Phœnicentron, Ehrb.

Navicula viridis, Kuetz.
major, Kuetz.
nobilis(Ehrb.), Kuetz.
rhomboides, Ehrb.
borealis(Ehrb.), Kuetz.
trinodis, Lewis.
var. ——————

Achnanthes lanceolata, Breb.

Synedra Ulna(Nitzsch.), Ehrh.

Nitzschia Amphioxys, *var* **intermedia**, Grun.

FUNGACEÆ.

AGARICACEÆ.

Leucosporeæ.

AMANITA, L.

A. muscaria, L.

Rooted on buried birch limb. Grant: near Bayard.

Forma, ——— .

A wartless form, apparently of this species, occurs on leaf mold in deep woods. Grant: near Bayard.

COLLYBIA, Fr.

C. dryophila, Bull.

In moss on log, in deep woods. Grant: near Bayard.

C. radicata, Rehl.

On leaf mold. Monongalia: Rich woods near Morgantown.

MYCENA, Fr.

M. galericulata, Scop.

Under dead oak twig. Under bark oak log. Monongalia: rich woods near Morgantown.

OMPHALIA, Fr.

O. campanella, Batsch. (in part).

On leaf mold, base of chestnut. Preston: near Terra Alta.

MARASMIUS, Fr.

M. opacus, B. & C.

On dead branch Rhododendron maximum, common. Grant: near Bayard.

M. rotula (Scop.), Fr.

On dead birch limb. Grant: near Bayard.

LENTINUS, Fr.

L. strigosus, Schw.

On dead Birch log. Grant: near Bayard.

PANUS, Fr.

P. stipticus (Bull.), Fr.

Under dead branch Oak. Monongalia: near Morgantown.

LENZITES, Fr.

L. sepiaria (Wulf.), Fr.

On decorticated spruce stumps. Tucker: near the Falls of Blackwater.

Forma ——

A resupinate form. On dead hemlock logs. Grant: near Bayard.

SCHIZOPHYLLUM, Fr.

S. commune, Fr.

On bark dead oak. Grant: near Bayard. On dead apple twig. Monongalia: near Morgantown.

Rhodosporæ or *Hyporrhodiæ.*

VOLVARIA, Fr.

V. bombycina (Pers.), Fr.

Monongalia: on insect (?), Morgantown.

Melanosporæ.

STROPHARIA, Fr.

S. stercoraria, Fr.

On decaying vegetable matter. Preston: near Terra Alta.

HYPHOLOMA, Fr.

H. sublateritium, Schaeff.

Under bark ash log. Monongalia: near Morgantown.

PANÆOLUS, Fr.

P. campanulatus, L.

On cow droppings, in deep coniferous woods. Grant: near Bayard.

POLYPORACEÆ.

POLYPORUS, Fr.

P. abietinus(Dicks.), Fr.

On fallen Hemlock logs. Grant: near Bayard.

P. adusts(Willd.), Fr.

On dead Sumach branch. In decayed hickory stump. Monongalia: near Morgantown.

P. applanatus (Pers.), Fr.

On dead Sugar Maple and Oaks. Wood: near Kanawha Station. McDowell: near Elkhorn. On dead ash log. Grant: near Bayard. Monongalia: near Morgantown. Frequent throughout the State.

P. Berkeleyi, Fr.

In dry exposed hollow in Oak stump. Monongalia: near Morgantown.

P. carneus, Nees.

On dead and decorticated Spruce stumps. Tucker: near the Falls of Blackwater.

P. fomentarius L.) Fr.

On dead Birch. Grant: near Bayard.

P. hirsutus(Wulf.), Fr.

On dead birch and apple twigs. On bark Liriodendron log. Monongalia: near Morgantown.

Forma ——

A small form, with white spores. On roots of fallen birch. Grant: near Bayard.

P. lucidus(Leyss.), Fr.

On dead hemlock logs. Preston: near Terra Alta.

P. sulphureus, Fr.

On decaying oak stump. Monongalia: near Morgantown.

P. umbellatus, Fr.

In dry exposed hollow of an oak stump. Monongalia: near Morgantown.

P. versicolor(L.), Fr.

On decorticated Spruce stumps. Tucker: near the Falls of Blackwater.

FOMES, Fr.

F. rimosus, Berk.
Exposed on dead Yellow Locust log. Monongalia: near Morgantown.

POLYSTICTUS, Fr.

P. hirsutus, Fr.
On dead Apple twig. Monongalia: near Morgantown.

P. pergamenus, Fr.
On dry exposed Oak railroad tie. Monongalia: near Morgantown.

P. cinnabarinus(Jacq.), Fr.
Monongalia: on dead limbs of cherry. Morgantown.

P. versicolor, Fr.
Under bark oak log. Monongalia: near Morgantown.

TRAMETES, Fr.

T. sepium, Berk.
On dry exposed oak railroad ties. Monongalia: near Morgantown.

MYRIADOPORUS, Pk.

M. induratus, Pk.
Probably only an imperfect condition of Poria abducens, Pers *fide* Pk. Top of decayed oak stump. Monongalia: near Morgantown.

GLŒOPORUS, Mont.

G. conchoides, Mont.
On oak chips. Monongalia: near Morgantown.

MERULIUS, Hall.

M. tremellosus, Schrad.
Under bark oak log. Monongalia: near Morgantown.

HYDNACEÆ.

IRPEX, Fr.

I. lacteus, Fr.
On dead sumach. Monongalia: near Morgantown.

THELEPHORACEÆ.

STEREUM, Fr.

S. complicatum, Fr.
On roots of fallen birch. Grant: near Bayard. On dry oak railroad ties. Monongalia: near Morgantown.

S. frustulosum(Pers.), Fr.
On oak log. Monongalia: near Morgantown.

S. sericeum, Schw.
On dead birch twig. Grant: near Bayard.

S. sulphuratum, B. & Rav.
On White Oak log. Monongalia: near Morgantown.

S. versicolor, Fr., *var.* ———
On dry Oak railroad ties. Monongalia: near Morgantown.

HYMENOCHÆTE, Lev.

H. corrugata(Fr.), Lev.
On decorticated birch limb. Grant: near Bayard.

EXOBASIDIUM, Weron.

E. Rhododendri, Cram.
Forming "cups" near the tips or margins of living leaves of Rhododendron maximum. Common in Grant and Tucker counties. I understand from Prof. Peck, that this is his first knowledge of the occurring of this species in North America.

CLAVARIACEÆ.

CLAVARIA, Vaill.

C. flaccida, Fr.
On leaf mold, in deep woods. Grant: near Bayard.

TREMELLACEÆ.

HYPSILOPHORA, Cke.

H fragiformis(Nees), Cke.
On bark dead Beech. Grant: near Bayard.

LYCOPERDACEÆ.

BOVISTA, Pers.

B. pila, B. & C.

Monongalia: free on open ground, Morgantown.

LYCOPERDON, Tourn.

L. pyriforme, Schaeff.

Under bark oak log. Monongalia: near Morgantown, near Little Falls.

SCLERODERMA, Pers.

S. vulgare, Fr.

On spruce chips. Tucker: near Falls of Blackwater. Monongalia: plentiful on clay of woodland path; Tibb's Run. Grant: on dead logs, Otter Fork of Cheat.

UREDINACEÆ.

Amerosporæ.

UROMYCES, Lev.

U. appendiculata(Pers.), Lev.

On living leaves of Pole Bean. Monongalia: near Morgantown.

U. Hedysari-paniculati(Schw.), Farl.

On living leaves *Desmodium canescens*. Mason: near Point Pleasant.

U. Lespedezæ(Sch.), Pk.

On living leaves *Lespedeza violacea*. Monongalia: near Morgantown.

U. Trifolii(A. & S.), Winter.

On living leaves *Trifolium pratense*. Mason: near Point Pleasant.

Didymosporæ.

PUCCINIA, Pers.

P. flosculosorum(A. & S.), Roehl.

On living leaves *Cnicus lanceolatus*. Mason: near Point Pleasant.

P. Pimpinellæ St.), Link.

On living leaves *Osmorrhiza Claytoni*. Monongalia: near Morgantown.

P. Rubigo-vera

On living leaves *Triticum sativum*. Wood: near Kanawha Station.

P. sauveolens(Pers.), Pk.

On living leaves *Cnicus lanceolatus*. Wood: near Kanawha Station.

GYMNOSPORANGIUM, DC.

G. macropus, Link.

Mercer: plentiful on living Junipers, near Princeton.

Phragmosporae.

PHRAGMIDIUM, Lk.

P. Potentillae(Pers.), Karst.

Monongalia: uredo on living leaves *Potentilla Canadensis*, near Morgantown.

COLEOSPORIUM. Lev.

C. Sonchi-arvensis(Pers.) Lev.

On living leaves of *Vernonia Noveboracense*, common. Mason: near Point Pleasant.

C. Senecionis(Pers.), *Peridermium Pini*, Auth., *P. acicola*, Rabh. *Aecidium Pini*, Pers.

Wood: æcidium on living leaves *Pinus mitis*, near Lockhart's Run.

Uredineæ Inferiores.

ÆCIDIUM. Pers.

A. Houstonianum. Schw.

Monongalia: spermagonia on living leaves *Houstonia cærulea*, near Morgantown.

ROESTELIA, Rebent.

R. Pyratum, Schw.

On living leaves roan-beauty apple. Wood: near Lockhart's Run. Cabell: near Huntington.

PERIDERMIUM. Chev.

P. Peckii.

Pocahontas: on living leaves *Tsuga Canadensis*, near Traveler's Repose.

P. balsameum. Pk.

Under surface living leaves *Abies Balsamea*. Randolph: at Shades-of-Death.

CÆOMA. Link.

C. nitens. Schw.

On living leaves *Rubus hispidus*. Monongalia: near Morgantown.

USTILAGINACEÆ.

Amerospora.

USTILAGO, Pers.

U. Maydis(DC.), Cda.

On living ears and tassels of sweet corn. Monongalia: near Morgantown, prevalent (1891).

U. segetum(Bull.), Ditm.

On living heads of wheat and oats. Monongalia: near Morgantown. Lewis: near Alum Bridge. Taylor: near Thornton.

U. Tritici(Pers.), Jensen.

On living leaves of wheat. Monongalia: near Morgantown.

Dictyosporeæ.

UROCYSTIS, Rabenh.

U. Anemones, Schrœb.

Monongalia: on living leaves and under bark of *Actæa*, Morgantown.

PERONOSPORACEÆ.

PHYTOPHTHORA. D. By.

P. infestans(Mont.), D. By.

On living potato leaves and tubers. Monongalia: near Morgantown.

P. obovata, Bonor.
On ? Tucker: near Davis.

CYSTOPUS, DeBy.

C. candidus(Pers.), Lev.
Monongalia: on living leaves *Dentaria diphylla*, Little Falls.

PERONOSPORA, Cda.

P. obovata, Bon.
Preston: on living leaves *Spergula arv.*, Terra Alta.

P. viticola.
On Grapes. Monongalia: near Morgantown.

ENTOMOPHTHORACEÆ.

EMPUSA, Cohn

E. Grylli(Fr.), Nowakow.
On tufted catapilar, on locusts, and on *Muscæ*. Monongalia: near Morgantown, plentiful (1891).

E. Muscæ(Fr.), Cohn.
On common house-fly; prevalent on a Tachina sp. on maples in 1892; Monongalia: Morgantown.

PERISPORIACEÆ.

(*Erysipheæ.*)
Amerosporæ.

PODOSPHÆRA, Kunze.

P. oxycantha(DC.), D. By.
On living Cherry, Thorn, and Persimmon. Monongalia: near Morgantown.

P. triadactyla(Waller.), D. By.
On living leaves cultivated Cherry. Cabell: near Huntington.

SPHÆROTHECA, Lev.

S. Humuli(DC.), Burrill.
On living leaves *Agrimonia Eupatoria*. Preston: near Terra Alta.

UNCINULA, Lev.

U. Ampelopsidis, Pk.

On grapes. Monongalia: near Morgantown.

ERYSIPHE (Hedw.), DC.

E. graminis, DC.

On living leaves *Poa pratensis*. Preston: near Terra Alta.

SPHÆRIACEÆ.

Phæosporae.

HYPOXYLON, Bull.

H. fuscum (Pers.), Fr.

On dead and decorticated maple. Grant: near Bayard.

DOTHIDEACEÆ.

Hyalosporæ.

PHYLLACHORA, Fckl.

P. graminis (Pers.), Fckl.

On living leaves of *Asprella Hysterix*. Fayette: near Nuttallburg.

PLOWRIGHTIA, Sacc.

P. morbosa (Schw.), Sacc.

Monongalia: on limbs of plum and cherry, Morgantown.

HYSTERIACEÆ.

LOPHIODERMIUM, Chev.

L. Pinastri (Schrad.), Chev.

Hampshire: on living leaves *Pinus inops*, Romney.

PEZIZACEÆ.

Hyalosporae.

PEZIZA, L.

(*Mollisia Karst.*)

P. cinerea, Batsch.

Monongalia: on decayed log, Morgantown.

P. aurelia, Pers.

Monongalia: on dead leaf in rotten log, Little Falls.

P. scutellata, L.
On dead bark in water. Grant: near Bayard.

LACHNEA. Fr.

L. erinaceus(Schw.)
Under side Oak log. Monongalia: near Morgantown.

L. scutellata(L.)
On rotting Beech log, and under bark wet Oak log. Monongalia: near Morgantown.

BULGARIACEÆ.

Phragmosporæ.

CORYNE, Tul.

C. urnalis(Nyl.), Sacc. *C. purpurea*, Fckl.
Rotting beech log, and under bark oak log. Monongalia: near Morgantown.

GYMNOASCACEÆ.

(*Exoasceæ.*)

TAPHRINA, Tul.

T. Pruni, Fck'.
On plums. Monongalia: near Morgantown.

T. deformans(Berk.), Tul.
On peach leaves. Jefferson: near Charlestown.

SACCHAROMYCETACEÆ.

SACCHAROMYCES, Myen.

S. cerevisiæ, Meyen.
In Pasteur's liquid left uncorked in labratory.

S. Mycoderma, Reess.
On same liquid as above.

SCHIZOMYCETACEÆ.

Baculogeneæ.

BACILLUS, Cohn.

B. acidi lactici.
In sour milk.

B. subtilis. Cohn.
In infusion of hay. On boiled potato.

B. tuberculosss. Koch.
In sputa of consumptives.

B. ulna, Cohn.
On boiled white-of-egg.

B. ———
Isolated from blood of self when suffering from "La Grippe."

SPIRILLUM. Ehrb.

S. undula (Muell.). Ehrb.
In infusion of hay.

BACTERIUM, Ehr. et. Trev.

B. lineola. Cohn.
In infusion of radish.

B. termo. Dujard.
In various decomposing organic substance.

B. ——— sp. nov. Mss.
Isolated from dead locusts.

MICROCOCCUS (Hall.). Cohn.

M. amylovorus. Burrill.
In "fire-blight" of Pears.

M aurantiacus. Cohn.
Caught on sterilized potato. In laboratory.

M. crepusculum, Cohn.
Found associated with *Bacterium termo* in decomposing infusions.

M. luteus, Cohn.
Caught on sterilized potato, In laboratory.

M septicus, Cohn.
Found in blood of dead calf.

M. ureæ, Cohn.
In decomposing urine.

MYXOMYCETACEÆ.
Tricophoræ.

TRICHIA. Hall.

T. chrysosperma(Bull.), DC.
Monongalia: on decayed wood, near Morgantown.

HEMIARCYRIA, Rostf.

H. clavata, Rostf.
Under bark of wet oak log. Monongalia: near Morgantown.

H. rubiformis, Rostf.
Under bark ash log. Under bark oak log. Monongalia: near Morgantown.

SPHÆRIOIDACEÆ.
Hyalosporae.

PHYLLOSTICTA, Pers.

P. acericola, C. & E.
On living leaves *Acer saccharinum*, L. Putnam: near Buffalo.

P. Asiminæ, E. & Kell.
On living leaves of *Asimina triloba*. Monongalia: near Camp Eden.

P. Labruscæ, Thun.
On living leaves Concord Grape. Wood: near Lockhart's Run.

Scolecospora.

SEPTORIA. Fr.

S. Rubi, West, et B. & C.
Wood: on living leaves *Rubus Canadensis*, Lockhart's Run.

S. Verbenæ, Ger.
On living leaves *Verbena urticifolia*. Jefferson: near Shenandoah Jc.

S. Kalmiæcola(Sch.) B. & C.
Monongalia: on living leaves of *Kalmia latifolia*, Camp Eden.

LEPTOSTROMACEÆ.

Phragmosporæ.

DISCOSIA, Fr.

D. maculæcola, Ger.
On living leaves *Disporum lanuginosum*. Grant: near Bayard.

ENTOMOSPORIUM, Lev.

E. maculatum Lev.
On living leaves and fruit of the pear. Monongalia: near Morgantown.

MELANCONIACEÆ.

Hyalosporae.

COLLETOTRICHUM. Cda.

C Lindemuthianum. Scrib.
Pods of wax butter-bean. Monongalia: near Morgantown.

Scoleco-allantosporae.

LIBERTELLA. Desm,

L. faginea, Desm. (*Quaternaria Persoonii*, Tul. *forma.*)
On bark of dead beech. Grant: near Bayard.

MUCEDINACEÆ.

Amerosporæ

MONILIA, Pers.

M. fructigena, Pers.
On cherries. Monongalia: near Morgantown.

OIDIUM, Link.

O. monilioides, Lk. *Conidia* of *Erysiphe graminis*, DC.
Preston: on living leaves *Poa pratensis*, near Terra Alta.

O. leucoconium. Desm. *Conidia* of *Sphærotheca pannosa*, Lev.
Cabell: on living leaves of *Rosa* cult., near Huntington.

HYPHODERMA, Fr.

H. Dezmanzieri, Duly.
Wood: on living leaves *Pinus mitis*, Lockhart's Run.

DEMATIACEÆ.

Didymosporæ.

FUSICLADIUM, Bon.

F. dendriticum,(Wallr.), Fckl.
On living leaves and fruit of the Apple. Monongalia: near Morgantown.

Phragmospora.

CERCOSPORA, Fr.

C. caulophylli, Pk.
On living leaves *Caulophyllum thalictroides*. Grant: near Bayard.

C. smilacis, Thun.
On living leaves Smilax. Monongalia: near Camp Eden.

Dictyosporae.

MACROSPORIUM, Fr.

M. Tomato, Cook.
On cultivated sp. tomato. Monongalia: near Morgangantown, not prevalent (1891).

SEPTOSPORIUM, Cda.

S. Equiseti, Pk. sp. nov. (MSS.).
Tips of living leaves of *Equisetum arvense*. Doddridge: near Center Point. Monongalia: on campus.

TUBERCULARIACEÆ.

(*Tubercularieæ Mucedineæ.*)
Amerosporæ.

TUBERCULARIA, Tode.

T. vulgaris.
On dead Sumac limbs. Monongalia: near Morgantown.

CYLINDROCOLA, Bon.

C. dendroctoni, Pk. n. sp.
Sporodochia minute, forming irregular masses, soft,

somewhat waxy, white or whitish; sporophores slender, abundantly branched above, often compacted below into a short stem-like base, spores catenulate, short cylindrical, subtruncate, colorless, .00016 to .0002 in. long, .00008 to .0001 broad.

On dead insects, *Dendroctonus frontalis*, beneath the bark of pine. Hampshire: near Romney, W. Va.

The insects are probably killed by this fungus as they lie dead in their burrows in the inner bark of the tree (*Pinus inops.*)

On some of the insects there is a cottony or flocculent mass of white mycelium interwoven in a somewhat reticulate manner, and collected in strings or bundles. It bears no fruit but is probably a luxurient growth of the mycelium of this fungus.

Occasionally the fungus seems to spread from the insect to bark immediately adjacent to it.

Phragmosphoræ.

BACTRIDIUM. Kunze.

B. flavum. K. & S.

Under bark wet Oak log. Monongalia: near Morgantown.

FUSARIUM. Desm.

F. Solani. Mart.

Found associated with the black rot on tomatoes that have fallen badly affected with the disease.

F. culmorum. Smith.

Monongalia: on heads living ripe wheat, Laurel Point.

"This specimen combines the characters of a number of so-called species, making it difficult to say which it really is. Probably they are all forms of one species." Prof. Peck (in letter).

Tuberculariæ Dematieæ.
Ameriosporæ.

EPICOCCUM, Lk.

E. neglectum, Desm.

On living leaves *Avena sativa* and *Catalpa Bignonioides.* Monongalia: near Morgantown.

CONCLUSION.

Although I have worked only two seasons among the plants of the State, as a side issue from my duties at the Experiment Station, I can not feel—notwithstanding the assistance of those who have kindly contributed toward this catalogue that much more than a beginning has been made toward a knowledge of the plant life within our boundaries. However, this rich field already makes a good showing, even when compared with the almost complete work, done by many observers combined, in other states, as will be noted by an examination of the following table:

	W. Va.	Col.	Mass.	Ohio.	Ark.	Neb.	N. Y.	Ills.	N. J.
Genera	**514**	430	443	453	562	562	533	551	
Species*	**1365**	1145	1162	1232	1233	1258	1330	1431	1995

* Anthophyta and Pteridophyta only.

Summary of the Flora.

	Genera.	Species.	Varieties.	Forms.	Total.
Anthophyta,	504	1189	109	23	1321
Pteridophyta,	15	39	4	1	44
Bryophyta,	66	107	6		113
Thallophyta,	94	164		3	167
Total,	679	1499	119	27	1645

Of these there are native of the State,	1452
Foreign,	193
Total species, varieties, and forms,	**1645**

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SUPPLEMENT.

FOSSIL FLORA.

In this preliminary list of the rich fossil flora of the State, I give simply an alphabetical arrangement of the genera and species, not deeming it necessary to enter into the classification or more detailed designation of the geological and geographical distribution than a simple mention of the localities, on account of the undeveloped condition of the work in this branch.

The major part of this list is kindly contributed to this publication by Mr. R. D. Lacoe from his extensive library and collections, the latter containing a large amount of material as yet unworked.

The study of the palaeobotany of this State has been already ably begun by Profs. I. C. White, and W. M. Fontaine, (F. & W.), who have published a work entitled "The Permian Flora," issued as Vol. PP of the Pennsylvania Second Geological Surbey.

ALETHOPTERIS.		
A. *aquilina*(Schl.), Schp.	Lower Barrens.	Ohio: Wheeling.
A. *gigas*, Gem.	Upper Barrens.	Marshall: Bellton.
A. *grandifolia*, Newby.	Conglomerate.	Fayette: Quinnimont
A. *Helenæ*, Lx.	Conglomerate.	Fayette: Quinnimont.
A. *lonchitica*(Br.), Schp.	Conglomerate.	Fayette: Quinnimont.
A. *Virginiana*, F. & W.	Waynesburg C.	Monongalia: Cassville.
ANNULARIA.		
A. *carinata*, Gutb	Waynesburg C.	Monongalia: Cassville.
		Doddridge: W. Union.
	Upper Barrens.	Marshall: Bellton.
A. *longifolia*, Br.	Waynesburg C.	Monongalia: Cassville.
	Waynesburg C.	Doddridge: W. Union.
A. *minuta*, Br.	Upper Barrens.	Monongalia: Blacksville.
A. *radiata*(Br.), St.	Waynesburg C.	Monongalia: Cassville.
A. *sphenophylloides*, Zenk.	Waynesburg C.	Monongalia: Cassville.
	Lower Barrens.	Ohio: Wheeling.
Var. *intermedia*, Lx.	Upper Barrens.	Monongalia: south of Jollytown, Pa.
	Upper Barrens.	Monongalia: Brown's Mills.

ARCHAEOPTERIS.		
A. obtusa, Lx.	Vespertine.	Greenbrier: Lewis Tunnel.
A. Alleghanensis(Meek.), Lx.	Vespertine.	Greenbrier: Lewis Tunnel.
A. Bockschiana(Goep.), Lx.	Vespertine.	Greenbrier: Lewis Tunnel.
A. Hibernica, Forb. (Lx.).	Vespertine.	Greenbrier: Lewis Tunhel.
ASTEROPHYLLITES.		
A. acicularis, Daws.	Conglomerate.	Fayette: Quinnimont, Sewell.
A. rigidus, Br.	L. Productive C. M.	
A. sublævis, Lx.	L. Productive C. M.	Kanawha:
BAIERA.		
B. Virginiana, F. & W.	Upper Barrens.	
CALAMITES.		
C. cannæformis, Schloth.	Lower Barrens.	Ohio: Wheeling.
	Conglomerate.	Fayette: Quinnimont, Sewell.
C. Cisti, Br.	Waynesburg C.	Monongalia: Cassville.
	L. Productive C. M.	Boone: Short Creek.
C. Suckowii, Br.	Waynesburg C.	Monongalia: Cassville.
	Waynesburg C.	Doddridge: W. Union.
CALLIPTERIDIUM.		
C. Dawsonianum, F. & W.	Waynesburg C.	Doddridge: W. Union.
	Waynesburg C.	Monongalia: Cassville, Dent's Run, Georgetown.
C. grandifolium, F. & W.	Waynesburg C.	Doddridge: W. Union.
	Waynesburg C.	Monongalia: Dent's Run. Georgetown.
C. Grandini, (Br.), Lx.	L. Productive C. M.	Kanawha: Campbell's Creek.
C. Massilioneum, Lx.	L. Productive C. M.	Boone: Short Creek.
C. oblongifolium, F. & W.	Waynesburg C.	Monongalia: Cassville, Dent's Run. Georgetown.
	Upper Barrens.	Marshall: Bellton.
C. odontopteroides, F. & W.	Waynesburg C.	Monongalia: Arnettsville, Cassville, Dent's Run, Georgetown.
C. unitum, F & W	Upper Barrens.	
CALLIPTERIS.		
C. conferta, Br.	Washington C.	Monongalia: Brown's Bridge, Brown's Mills Dunkard Creek.
CARDIOCARPUS.		
C. longicollis. Lx.	L. Productive C. M.	Kanawha: Campbell's Creek.
C. ellipticus var. *rugosus*. MSS.	L. Productive C. M.	Kanawha: Malden mine.

CARDIOPTERIS.		
C. frondosa, Schimp.	Vespertine	Greenbrier: Lewis Tunnel.
CARPOLITHES.		
C. bicarpa, F. & W.	Waynesburg C.	Monongalia: Cassville.
C. marginatus, F. & W.	Waynesburg C.	Monongolia: Cassville.
CAULOPTERIS.		
C. elliptica, F. & W.	Waynesburg C.	Monongalia: Cassville.
C. gigantea, F. & W.	Waynesburg C.	Monongalia: Cassville.
CORDIATES.		
C. borassifolius (St.). Ung.	Lower Barrens.	Ohio: Wheeling.
C. crassinerris, F. & W.	Waynesburg C.	Monongalia: Cassville.
CYMOGLOSSA.		
C. obtusiloba, F. & W.	Waynesburg C.	Monongalia: Cassville.
C. brevilobata, F. & W	Waynesburg C.	Monongalia: Cassville.
C. formosa, F. & W.	Waynesburg C.	Monongalia: Cassville,
C. lobata, F. & W.	Waynesburg C.	Monongalia: Cassville.
EQUISITITES.		
E. elongatus, F. & W.	Waynesburg C.	Doddridge: W. Union.
? *E. rugosus*, Schimp.	Waynesburg C.	Doddridge: W. Union.
E. striatus, F. & W.	Waynesburg C.	Doddridge: W. Union.
EREMOPTERIS.		
E. artemisiaefolia, Brgt., Schp	L. Productive C. M.	Kanawha: Coalmont.
E. Cheathami, Lx.	L. Productive C. M.	Kanawha: Bl'ksburg.
GONIOPTERIS.		
G. elliptica, F. & W.	Waynesburg C.	Monongalia: Cassville.
G. Newberriana, F. & W.	Waynesburg C.	Doddridge: W. Union.
G. oblonga, F. & W.	Waynesburg C.	Doddridge: W. Union.
GUILIELMITES.		
G. orbicularis, F. & W.	Waynesburg C.	Monongalia: Cassville.
LEPIDODENDRON.		
L. clypeatum, Lx.	L. Productive C. M.	
L. selaginoides, Sternb.	Conglomerate.	Fayette: Quinnimont, Sewell.
L. Sternbergi, Br.	L. Productive C. M.	
	Vespertine.	Greenbrier: Lewis Tunnel.
L. *Veltheimianum*, Sternb.	Vespertine.	Greenbrier: Lewis Tunnel.
LEPIDOSTROBUS.		
L. ornatus, L. & H.	L. Productive C. M.	Kittanning Coal.
L. Salisburyi, Lx.	L. Productive C. M.	Coal river.

LESCUROPTERIS.		
L. adiantites, Lx.	Waynesburg C.	Monongalia: Georgetown.
L. Moorei (Lx), Schp.	Lower Barrens.	Ohio: Wheeling.
MEGALOPTERIS.		
M. Harttii, Andr.	Conglomerate.	Fayette: Quinnimont, Sewell.
M. Sewellensis, Font.	Conglomerate.	Fayette: Sewell.
NEMATOPHYLLUM.		
N. angustum, F. & W.	Waynesburg C.	Monongalia: Cassville.
	Waynesburg C.	Doddridge: W. Union.
NEUROPTERIS.		
N. acutifolia, Br.	Lower Barrens.	Ohio: Wheeling.
	L. Productive C. M.	Upper Freeport C.
N. auriculata, Br.	Waynesburg C.	Monongalia: Cassville, Arnettsville.
	Waynesburg C.	Doddridge: W. Union.
	Upper Barrens.	Marshall: Bellton.
N. biformis, Lx.	Kittanning C.	Kanawha: Blacksburg.
N. Clarksoni, Lx.	Kittanning Coal.	
N. cordata, Br.	Waynesburg C.	Monongalia: Cassville.
	Waynesburg C.	Doddridge: W. Union.
	Upper Barrens.	Monorgalia: Brown's Mills.
N. dictyopteroides, F. & W.	Waynesburg C.	Doddridge: W. Union.
	Upper Barrens.	Marshall: Bellton.
N. fimbriata, Lx.	Waynesburg C.	Monongalia: Arnettsville.
	L. Productive C. M.	Kanawha River.
N. flexuosa, Br.	Waynesburg C.	Doddridge: W. Union.
	Upper Barrens.	Monongalia: Brown's Mills.
	Lower Barrens.	Ohio: Wheeling.
	L. Productive C. M.	Upper Freeport C.
	L. Productive C. M.	Kittanning C.
Var. *longifolia*, F. & W.	Waynesburg C.	Doddridge: W. Union.
N. gibosa, Lx.	Upper Barrens.	Monongalia: Brown's Mills.
N. Grangeri, Br.	Lower Barrens.	Ohio: Wheeling.
N. heterophylla, Br.	Upper Barrens.	Monongalia: Brown's Mills.
	L. Productive C. M.	Kittanning Coal.
N. hirsuta, Lx.	Upper Barrens,	(throughout.)
	Lower Barrens.	Ohio: Wheeling.
	L. Productive C. M.	Kittanning Coal.
	L. Productive C. M.	Upper Freeport C.
N. Loschii, Br.	Waynesburg C.	Monongalia: Cassville.
	Upper Barrens.	Monongalia: Brown's Mills.
	Lower Barrens.	Ohio: Wheeling.

N. obscura, Lx	Upper Barrens	Monongalia: Brown's
N. odontopteroides, F & W	Waynesburg C	Monongalia: Cassville, Dent's Run.
	Waynesburg C.	Doddridge: W. Union.
	Upper Barrens.	Monongalia: Brown's Mills.
N. [illegible], Sternb	Upper Barrens.	Monongalia: Brown's Mills.
N. rarinervis, Bunby	Lower Barrens.	Ohio: Wheeling.
	L. Productive C. M.	Upper Freeport C.
	L. Productive C. M	Kittanning Coal.
N. Scheuchzeri, Br.	Waynesburg C.	Monongalia: Cassville.
	Upper Barrens.	Monongalia: Brown's Mills.
N. Smithii, Lx.	Conglomerate.	Fayette: Qunnimont, Sewell.
N. tenuifolia, Br.	Waynesburg C.	Monongalia: Arnetts-ville.
	L. Productive C. M.,	Kanawha: Blacks-burg, Coalburg.
	Conglomerate,	Fayette: Quinnimont, Sewell.
ODONTOPTERIS.		
O. densifolia, F. & W.	Waynesburg C.	Monongalia: Cassville.
O. gracillima, Newby.	Conglomerate.	Fayette: Quinnimont, Sewell.
O. nervosa, F. & W.	Waynesburg C.	Monongalia: Cassville.
	Waynesburg C.	Doddridge: W. Union.
O. neuropteroides, Newby.	Conglomerate.	Fayette: Quinnimont, Sewell.
O. Newberryi, Lx.	Conglomerate.	Fayette: Quinnimont, Sewell.
O. obtusiloba.	Conglomerate.	Fayette: Quinnimont, Sewell.
var. *rarinervis*. F. & W.	Upper Barrens.	Marshall: near Bellton.
O. *pachyderma*, F. & W.	Waynesburg C.	Monongalia: Cassville.
	Waynesburg C.	Monongalia: Dent's Run.
O. Reichiana, F. & W.	Waynesburg C.	Monongalia: Cassville.
	Upper Barrens.	Monongalia: Brown's Mills.
O. sphenopteroides, Lx.	L. Productive C. M.	Kanawha: Blacks-burg.
	L. Productive C. M.	Boone: Short creek.
O. subcuneata, Bunby	Waynesburg C.	Monongalia: Arnettes-ville.
	L. Productive C. M.	Upper Freeport C.
O. tenuinervis, Lx.	Upper Barrens.	Monongalia: Brown's Mills.
?*O. Worthenii* Lx	Waynesburg C.	Monongalia: Cassville.

PECOPTERIS.

P. angustipinna, F. & W.	Waynesburg C.	Monongalia: Cassville.
	Waynesburg C.	Monongalia: Dent's Run.
	Waynesburg C.	Doddridge: West Union.
P. arborescens (Schl.), Br.	Waynesburg C.	Monongalia: Cassvilie.
	Waynesburg C.	Doddridge: W. Union.
	Upper Barrens.	Marshall. Bellton.
	L. Productive C. M.	Upper Freeport C.
Var. *integrapinna*. F. & W.	Waynesburg C.	Monongalia: sta.?
	Upper Barrens, in coal.	Marshall: Tyler.
P. arguta, Sternb.	Waynesburg C.	Monongalia: Cassville.
	Waynesburg C.	Doddridge: W. Union.
P. asplenoides. F. & W.	Waynesburg C.	Monongalia: Cassville.
P. Bucklandii. Br.	Lower Barrens.	Ohio: Wheeling.
P. Candolliana, Br.	Lower Barrens.	Ohio: Wheeling.
	Waynesburg C.	Doddridge: W. Union.
P. Cisti. Br.	L. Productive C. M.	sta.?
P. dentata. Br.	Waynesburg C.	Monongalia: Cassville.
	Lower Barrens.	Onio: Wheeling.
Var. *crenata*. F. & W.	Waynesburg C.	Monongalia: Cassville.
Var. *parva*, F. & W.	Waynesburg C.	Monongalia: Cassville.
P. elegans, Germ.	Waynesburg C.	Monongalia: Cassville.
P. elliptica, Bunby.	Waynesburg C.	Monongalia: Cassville.
P. emarginata (Goep.), Bunby.	Waynesburg C.	Monongalia: Cassville.
	Upper Barrens.	Marshall: Bellton.
P. Germari (Weiss.), F. & W.	Waynesburg C.	Monongalia: Cassville.
	Waynesburg C.	Doddridge: W. Union.
Var. *crassinervis*, F. & W.	Waynesburg C.	Doddridge: W. Union.
Var. *cuspidata*, F. & W.	Waynesburg C.	Doddridge: W. Union.
P. goniopteroides, F. & W.	Waynesburg C.	Monongalia: Cassville.
P. Heeriana, F. & W.	Waynesburg C.	Monongalia: Cassville.
P. imbricata, F. & W.	Waynesburg C.	Monongalia: Cassville.
P. inclinata, F. & W.	Waynesburg C.	Monongalia: Cassville.
P. lanceolata, F. & W.	Waynesburg C.	Monongalia: Cassville.
	Waynesburg C.	Onio: Moundsville.
	Upper Barrens.	Marshall: Belton.
P. latifolia. F. & W.	Waynesburg C.	Monongalia: Cassville.
	Upper Barrens.	Marshall: Bellton.
P. longifolia, Br.	Waynesburg C.	Monongalia: Cassville.
P. merianiopteroides. F. & W.	Waynesburg C.	Monongalia: Cassville.
P. microphylla, Br.	Waynesburg C.	Monongalia: Cassville.
P. Miltonii, Br.	Waynesburg C.	Monongalia: Cassville.
	Waynesburg C.	Marshall: W. Union.
P. notata. Lx.	U. Productive C. M.	Ohio: Wheeling.
	Lower Barrens.	Ohio: Wheeling.
P. oreopteridia (Schloth.), Br.	Upper Barrens.	Marshall: Bellton.
P. ovoides, F. & W.	Upper Barrens.	Marshall: Bellton.
P. pachypteroides, F. & W.	Waynesburg C.	Monongalia: Cassville.
P. pennaeformis, Br.	Waynesburg C.	Monongalia: Cassville.
Var. *latifolia*. F. & W.	Waynesburg C.	Monongalia: Cassville.
P. platynervis, F. & W.	Waynesburg C.	Monongalia: Cassville and Dent's run.

P. pteroides, Br.	Waynesburg C.	Doddridge: West Union.
	Waynesburg C.	Monongalia: Cassville and Arnettsville.
	Lower Barrens.	Ohio: Wheeling.
	L. Productive C. M.	Kanawha Sta. ?
P. rarinervis, F. & W.	Waynesburg C.	Monongalia: Cassville.
P. rotundifolia, F. & W.	Waynesburg C.	Monongalia: Cassville.
	Upper Barrens.	Monongalia: Wisce.
P. rotundiloba, F. & W.	Waynesburg C.	Monongalia: Cassville.
P. Schimperana, F. & W.	Waynesburg C.	Doddridge: W. Union and Monongalia: Cassville.
P. subfalcata, F. & W.	Waynesburg C.	Monongalia: Cassville.
P. tenuinervis, F. & W.	Waynesburg C.	Monongalia: Cassville and Arnettsville.
	Upper Barrens.	Monongalia: south of Jollytown, Pa., in W. Va.
P. villosa, Br.	L. Productive C. M.	Upper Freeport C.
	L. Productive C. M.	Kittanning Coal.

PSEUDOPECOPTERIS (from Pecopteris.).

P. muricata (Br.), Lx.	Conglomerate.	Fayette: Quinnimont, Sewell.
P. nervosa (Br.), Lx.	Conglomerate.	Fayette: Quinnimont, Sewell.
P. Pluckenetii (Br.), Lx.	Lower Barrens.	Ohio: Wheeling.
P. latifolia (Br.), Lx.	L. Productive C. M.	Kanawha: Coalmont.
P. macilenta (Llott.), Lx.	L. productive C. M.	Kanawha: Coalmont.
	Conglomerate.	Fayette: Qunnimont and Sewell.
P. cordato-ovata (Weiss.), Lx.	Waynesburg C.	Monongalia: Cassville.
P. obtusiloba (Br.), Lx.	L. Productive C. M.	Kanawha: Wyoming Mine near Upper Creek.
	Conglomerate.	Fayette: Quinnimont and Sewell.
	L. Productive C. M.	Boone: Peytona.
P. obtusiloba, var. *dilatata* (Ll. & H.), Lx.	L. Productive C. M.	Boone: Short Creek.
P. Virginiana (Meek), Lx.	Pocono or Vespertine.	Greenbrier: Lewis Tunnel.
P. spinulosa, Lx.	Lower Barrens.	Ohio: Wheeling.
P. Andreana (Roehl.), Lx.	L. Productive C. M.	Kanawha: Blacksburg, Coalmont.

RHABDOCARPUS.

R. oblongatus, F. & W.	Waynesburg C.	Monongalia: Cassville.
R. Bockschianus, G. & B.	L. Productive C. M.	Kanawha: Campbell's Creek.
R. clavatus, (St.), Gein.	L. Productive C. M.	Kanawha: Blacksburg.
	L. Productive C. M.	Kanawha: Malden Mines.

R. multistriatus (Presl.), Lx.	L. Productive C. M.	Kanawha: Campbell's Creek.
R. tenax, Lx.	L. Productive C. M.	Kanawha: Campbell's Creek.
RHACOPHYLLUM.		
R. filiciforme (Gutb.), Schp.	Lower Barrens.	Ohio: Wheeling.
Var. *majus*, F. & W.	Waynesburg C.	Monongalia: Cassville.
R. laciniatum, F. & W.	Waynesburg C.	Monongalia: Cassville.
R. lactuca (St.), Schp.	Waynesburg C.	Monongalia: Cassville.
	Waynesburg C.	Doddridge: West Union.
R. speciocissimum, Schp.	Waynesburg C.	Doddridge: West Union.
SAPORTÆA.		
S. grandifolia, F. & W.	Waynesburg C.	Monongalia: Cassville.
S. salisburioides, F. & W.	Waynesburg C.	Monongalia: Cassville.
SIGILLARIA.		
S. approximata, F. & W.	Waynesburg C.	Monongalia: Arnettsville.
S. Menardii, Br.	Upper beds above the Pittsburg coal.	
S. scutellata, Br.	L. Productive C. M.	Sta. ?
SPHENOPHYLLUM.		
S. angustifolium, Germ.	Waynesburg C.	Monongalia: Cassville, Dent's Run.
	Upper Barrens.	Monongalia: Wadestown.
S. densifoliatum, F. & W.	Waynesburg C.	Monongalia: Cassville.
S. erosum, L. & H. (trifoliatum)	Lower Barrens.	Ohio: Wheeling.
S. filiculme, Lx.	Lower Barrens.	Ohio: Wheeling.
	Waynesburg C.	Monongalia: Cassville.
	Waynesburg C.	Doddridge: W. Union.
S. latifolium, F. & W.	Waynesburg C.	Doddridge: W. Union.
	Waynesburg C.	Monongalia: Cassville.
S. longifolium, Germ.	Waynesburg C.	Monongalia: Cassville.
	Waynesburg C.	Doddridge: W. Union.
S. oblongifolium, Germ.	Waynesburg C.	Monongalia: Cassville.
	Upper Barrens.	Monongalia: south of Jollytown, Pa.
S. Schlotheimii, Br.	L. Productive C. M.	Upper Freeport C.
	L. Productive C. M.	Kittanning Coal.
S. tenuifolium, F. & W.	Waynesburg C.	Monongalia: Cassville.
	Upper Barrens.	Monongalia: south of Jollytown, Pa.
	Waynesburg C.	Doddridge: W. Union.

(*S. densifoliatum* and *S. tenuifolium* are considered by Lesquereaux to belong to *S. angustifolium*, Germ.)

SPHENOPTERIS		
S. acrocarpa, F. & W.	Waynesburg C.	Monongalia: Cassville.
S. adiantoides, L. & H.	Conglomerate.	Fayette: Quinnimont. Sewell.
S. auriculata, F. & W.	Waynesburg C.	Monongalia: Cassville.

S. coriacea, F. & W.	Upper Barrens. Monongalia: Brown's Bridge.
S. dentata, F. & W.	Waynesburg C. Monongalia: Cassville.
S. Dubuissionis, Br.	Lower Productive C. M. Kanawha Co.
S. foliosa, F. & W.	Waynesburg C. Monongalia: Cassville. Upper Barrens. Monongalia: South of Jollytown, Pa.
S. tenella, Br.	Lower Productive C.M. Kanawha: Malden Mines.
S. elegans, Br.	Lower Productive C.M. Kanawha: Malden Mines.
S. furcata, Br.	Lower Barrens. Ohio: Wheeling.
S. hastata, F. & W.	Waynesburg C. Monongalia: Cassville
S. Hildrethii, Lx.	L Productive C. M. Kanawha Co.
S. Heninghausii, Br.	Conglomerate. Fayette: Quinnimont Sewell.
S. Lescuriana, F. & W.	Waynesburg C. Doddridge: West Union.
S. minutisecta, F. & W.	Waynesburg C. Doddridge: West Union. Lower Barrens. Ohio: Wheeling.
S. pachynervis, F & W.	Waynesburg C. Doddrige: West Union.
S. tridactyllites, Br.	L. Productive C.M. Kanawha Co.
S. Gravenhorstii, Br.	L. Productive C. M. Kanawha Blacksburg.
SYRINGODENDRON.	
S. pes-capreoli,* St.	Lower Barrens. Ohio: Wheeling.
TÆNIOPTERIS.	
T. Lescuriana, F. & W.	Waynesburg C. Monongalia: Cassville.
T. Newberryana, F. & W.	Waynesburg C. Monongalia: Cassville.?
Var. *angusta*, F. & W.	Waynesburg C. Monongalia: Cassville.?
TRIGONOCARPUS.	
T. Noeggerathii, Br.	L. Productive C. M. Kanawha: Campbell's Creek and Malden Mine.
T. ampullaeformis, Lx.	L. Productive C. M. Kanawha: Malden Mine.
TRIPHYLLOPTERIS.	
T. Lescuriana (Meek.), Lx.	Vespertine. Greenbrier: Lewis Tunnel.

**Syringodendron pes-capreoli*, is Sternberg's genus and species, and may be credited accordingly. Geinitz described it as *Sigillaria Brongniarti*, and transferred Stanberg's sp. to *Sigillaria*. Schimper made Sternberg's species a synonym of Geinitz' *Sigillaria Brongniarti* and Lesquereux transfers the united species to *Syringodendron*, like Schimper using Geinitz' specific name, which if followed, makes it *Syringodendron Brongniarti* (Gein). Lx., or if Sternberg's specific name is adopted, *Syringodendron pes-capreoli*, St. Either is admissible. I followed Prof. Lesqx. though Sternberg has priority of name, but probably lacked in satisfactory description, giving Geinitz' name, given above, the preference.—R. D. Lacoe.

INDEX.

ERRATA.

P. 316 line 32 for "or name initial" read: name or initial.
P. 317 line 1 erase "nore."
P. 320 line 18, for "alt. 200 ft." read: alt. 2000 ft.
P. 323 line 13, for "**Z. apiifolia**" read: **X. apiifolia**.
P. 327 line 13 **NECKERIA**, as a genus also appears on page 494 in Musci. I have not the opportunity to properly determine which should stand; doubtless the moss.
P. 333 line 16 insert:

> **V. canina**, L. var. **Muhlenbergii**(Torr.), Gray.
> Fayette: at foot of cliff near Nuttallburg—L. W. N.

P. 349 line 24, for "woons" read: woods.
P. 468 line 18, for **PHLARIS**, read: **PHALARIS**.

VOLUME III. NUMBER 1.

Bulletin No. 25

WEST VIRGINIA

Agricultural Experiment Station

MORGANTOWN, W. VA.

PLAT EXPERIMENTS

WITH

COMMERCIAL FERTILIZERS

ON

WHEAT.

August, 1892.

CHARLESTON, WEST VA.
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PLAT EXPERIMENTS WITH COMMERCIAL FERTILIZERS ON WHEAT.

By D. D. Johnson.

For the purpose of these experiments, two and one-half acres were selected at each of the Out-Stations and divided into plats of one quarter of an acre each. The plats are placed side by side in the order in which they are named in the tables except at the Out Station in Doddridge county, at which Out-Station plat No. 11, lies on the outside of plat No. 1, and is in fact the beginning of the series. All of the plats except No. 11 above referred to, are parallelograms; each plat being 247½ feet long and 43½ feet wide, the plats being separated from each other by strips of land three feet wide which were neither fertilized nor seeded. Plats, Nos. 1 and 6, at three of the Out-Stations were not fertilized. Through a mistake of the farmer. Plats Nos. 1 and 6 were omitted and plat No. 11 was left unfertilized at the Out-Station in Roane County.

The fertilizers used to supply the necessary plant food were Kainit, containing 14 per cent. of Potash; Muriate of Potash containing 50% of Potash; Sulphate of Potash containing 25% of Potash; Nitrate of Soda containing 15% of Nitrogen; Dried Blood containing 12% of Nitrogen; Ground Fish containing 7.5% of Nitrogen and 4.5% of Available Phosphoric Acid; Tankage containing 5.5% of Nitrogen and 12% of Available Phosphoric Acid; South Carolina Dissolved Bone containing 14% of Available Phosphoric Acid and 11% of Sulphate of Lime; Dissolved Bone Black containing 17% of Available Phosphoric Acid and 13.5% Sulphate of Lime, and Stable Manure.

The Sulphate of Potash was applied at the rate of 200 lbs. per acre; the Nitrate of Soda, Dried Blood and Muriate of Potash each at the rate of 160 lbs. per acre; the Ground Fish at the rate of 240 lbs. per acre; the S. C. Dissolved Bone and the Dissolved Bone Black each at the rate of 320 pounds per acre; the Tankage at the rate of 400 pounds per acre; the Kainit at the rate of 450 pounds per acre, and the Stable Manure at the rate of 16 tons per acre. The cost of the fertilizers is calculated at the retail price in Baltimore in April 1891, and does not include freight, handling, etc.

TABLE A.

Showing the results of the use of Fertilizers in growing wheat at the Experimental Out-Station in Marshall County, in charge of Jeremiah Fish, Esq.

Number of Plat.	Fertilizers Applied.	Weight of Wheat.	Weight of Straw.	Yield Per Acre.		Increased Yield per Acre.		Value of Increased Yield.	Cost of Fertilizers.	Profit per Acre.	Loss per Acre.
		Lbs		Bu.	Lbs	Bu.	Lbs	Dols.	Dols.	Dols.	Dols.
1	Nothing	270½	301	18	2	......	......	....	....	....	....
2	50 lbs. Sulph. Potash, 40 lbs. Nitr. Soda and 40 lbs. Dried Blood........	238	283½	15	52	−2	8	−1.60	8.84	....	10.44
3	40 lbs. Mur. Potash & 60 lbs. Ground Fish..................	368	423	24	32	6	32	4.90	6.20	....	1.30
4	40 lbs. Mur. Potash and 80 lbs. S. C. Diss. Bone..........	348¼	422½	23	13	5	13	3.91¼	5.36	....	1.44¾
5	100 lbs. Tankage, 80 lbs. S. C. Diss. Bone and 40 lbs. Mur. Potash.......	423	548	28	12	10	12	7.65	9.76	....	2.11
6	Nothing	269½	401½	17	58	......	......	....	....	....	....
7	40 lbs. Dried Blood and 40 lbs. Mur. Potash	385¾	485¼	25	43	7	43	5.78¼	6.00	....	0.21¼
8	80 lbs. Diss. Bone Black	382½	592½	25	30	7	30	5.62½	2.88	2.74½	....
9	112½ lbs. Kainit......	313½	461	20	54	2	54	2.17½	2.58¾	....	0.41¼
10	40 lbs. Nitrate Soda	280½	909	18	42	0	42	0.50½	3.04	....	2.53½

TABLE B.

Showing the results of the use of Fertilizers in growing wheat at the Experimental Out-Station in Doddridge county, in charge of N. E. Duckworth, Esq.

Number of Plat.	Fertilizers Applied.	Weight of Wheat.	Weight of Straw.	Yield per Acre.		Increased Yield per Acre.		Value of Increased Yield.	Cost of Fertilizers per Acre.	Profits per Acre.	Loss per Acre.
		Lbs	Lbs	Bu.	Lbs	Bu.	Lbs	Dolls.	Dolls.	Dolls.	Dolls.
1	Nothing	280	481	18	40	......	......	$........	$........	$........	$........
2	50 lbs. Sulph. Potash, 40 lbs. Nitr. Soda and 40 lbs. Dried Blood	253	423½	16	52	−1	48	−2 10	8 84	....	10 94
3	40 lbs. Mur. Potash and 60 lbs. Gro'nd Fish	308	480½	20	32	1	52	2 15	6 20	....	4 05
4	40 lbs. Mur. Potash and 80 lbs. S. C. Diss. Bone	278½	386½	18	34	......	−6	−07½	5 36	....	5 43½
5	100 lbs. Tankage, 80 lbs. S. C. Diss. Bone, 40 lbs. Mur. Potash	282½	433½	18	50	......	10	12½	9 76	....	9 63½
6	Nothing	243	379	16	12	......	......	....	....	....	....
7	40 lbs. Dried Blood and 40 lbs. Mur. Potash	228	333	15	12	−1	......	−75	6 00	....	6 75
8	80 lbs. Diss. Bone Black	227½	392½	18	10	1	58	2 72½	2 88	....	15½
9	112½ lbs. Kainit	220	366	14	40	−1	32	−1 90	2 58¾	....	4 48¾
10	40 lbs. Nitr. Soda	138	482	9	12	−7	......	−5 25	3 04	....	8 29
11	8,000 lbs. Stable Manure	363	507	24	12	5	32	4 15	4 00	15	....

TABLE C.

Showing the results of the use of Fertilizers in growing wheat at the Experiment Out-Station in Wood County, in charge of S. S. Stone, Esq.

Number of Plat.	Fertilizers Applied.	Weight of Wheat.	Weight of Straw.	Yield per Acre.		Increased Yield per Acre.		Value of Increased Yield.	Cost of Fertilizers per Acre.	Profits per Acre.	Loss per Acre.
		Lbs	Lbs.	Bu.	Lbs	Bu.	Lbs	Dols.	Dols.	Dols.	Dols.
1	Nothing................	224½	340½	14	58	......	......	$.......	$.......	$.......	$.......
2	50 lbs. Sulph. Potash, 40 lbs. Nitr. Soda and 40 lbs. Dried Blood.......	340	546	22	40	5	49	4 36¼	8 84	....	4 47¾
3	40 lbs. Mur. Potash & 60 lbs. Ground Fish..................	341	425	22	44	5	53	4 41½	6 20	....	1 78½
4	40 lbs. Mur. Potash and 80 lbs. S. C. Diss. Bone..........	316½	358	20	58	4	7	3 08¾	5 36	....	2 27½
5	86⅔ lbs. Tankage, 13⅓ lbs. Ground Fish, 10½ lbs. S. C. Diss. Bone, 69½ lbs. Diss. Bone Bl'k, 40 lbs. Mur. Potash................	358½	439½	23	54	7	3	5 28¾	9 66½	....	4 37.8
6	Nothing................	281	405	18	14	......	......	....	....	....	....
7	40 lbs. Dried Blood and 40 lbs. Mur. Potash	335	393	22	20	5	29	4 11¼	6 00	....	1 88¼
8	80 lbs. Diss. Bone Bl'k....................	298	352½	19	52	3	1	2 26¼	2 88	....	0 61¾
9	112½ lbs. Kainit......	317	358½	21	8	4	17	3 21¼	2 58¾	0 62½	....
10	40 lbs. Nitr. Soda...	298	408½	19	52	3	1	2 26¼	3 04	....	0 77¾
11	40 lbs. Nitr. Soda...	272	420	18	8	1	17	0 86¼	3 04	....	2 17¾

TABLE D.

Showing the results of the use of Fertilizers in growing wheat at the Experimental Out-Station in Roane county, in charge of J. G. Schilling, Esq.

Number of Plat.	Fertilizers Applied.	Weight of Wheat.	Weight of Straw.	Yield per Acre.		Increased Yield per Acre.		Value of Increased Yield.	Cost of Fertilizers per Acre.	Profits per Acre.	Loss per Acre.
		Lbs	Lbs	Bu.	Lbs	Bu.	Lbs	Dolls.	Dolls.	Dolls.	Dolls.
1	Nothing...............	......	......	......	......	......	......	$... ...	$........	$........	$........
2	50 lbs. Sulph Potash, 40 lbs. Nitr. Soda and 40 lbs. Dried Blood.	90	202	6	......	1	48	1 35	8 84	....	7 49
3	40 lbs. Mur. Potash and 60 lbs. Gro'nd Fish..................	145	285	9	40	5	28	4 10	6 20	....	2 10
4	40 lbs. Mur. Potash and 80 lbs. S. C. Diss. Bone.........	185	265	12	20	8	8	6 10	5 36	74	....
5	86⅔ lbs. Tankage, 13⅓ lbs. Ground Fish, 10⅓ lbs. S. C. Diss. Bone, 69½ Diss. Bone Black and 40 lbs. Mur. Potash	198	324	13	12	9	.....	6 75	9 66½	....	2 91½
6	Nothing...............	......	......	......	......	......	......	....	....	....	....
7	40 lbs. Dried Blood and 40 lbs. Mur. Potash	101	286	6	44	2	32	1 90	6 00	....	4 10
8	80 lbs. Diss. Bone Black................	167	298	11	8	6	56	5 20	2 88	2 32	....
9	112½ lbs. Kainit......	88	207	5	52	1	40	1 25	2 58¾	....	....
10	40 lbs. Nitr. Soda...	70	180	4	40	......	28	35	3 04	....	1 33¾
11	Nothing...............	63	192	4	12	......	......	....	....	....	2 69

The Out-Station in Marshall county is located on both sides of a ridge running east and west. On the south side of the ridge the ground slopes at an angle of about 15 degrees. On the north side it slopes at an angle of about 25 degrees. Plats Nos. 1, 2, 3 and 4 are located on the south side of the ridge. Plat No. 5 lies on the top of the ridge, the east end being slightly on the south side, and the west end slightly on the north side. Plats Nos. 6, 7, 8, 9 and 10 are located on the north side of the ridge.

The unfertilized Plats Nos. 1 and 6 show the remarkable yield of an average of 18 bushels per acre, there being a difference of only 4 pounds of grain per acre in the yield of each of these plats, yet we find that while Plat 6 produced one pound less of grain, it produced 100½ pounds more of straw than Plat 1. The average production of grain of the ten plats is 329.95 pounds and the average production of straw is 482.72 pounds, making an average of 154.77 pounds more of straw than of grain. But if we eliminate from this calculation Plat 10, where we find a very remarkable abnormal yield of both grain and straw, we have an average yield of grain of 333.27 pounds and an average yield of straw of 435.36 pounds, or an average yield of a little more than 102 pounds of straw more than of grain.

The average yield of grain on the unfertilized plats is 270 pounds and of straw 351¼ pounds, showing that the increased yield of grain or straw produced by the use of commercial fertilizers is, for grain about 23½% and for straw about 24%, or practically the same. What effect the different kinds of fertilizers have upon the production of straw is a very difficult question to determine from this experiment. By comparing the unfertilized plats 1 and 6 we find that while each produces substantially the same amount of grain, plat 6 produces 33% more straw than plat 1.

Let us compare plats 7 and 8. Plat 7 has 4.8 pounds of Nitrogen and 20 pounds of Potash, and plat 8 has 15.6 pounds of Phosphoric Acid, and while each plat produces substantially the same amount of grain, plat 8 with about one-half the amount of fertilizer (but of a different kind) produces a little more than 22% more of straw than plat 7.

Again, take plats 4 and 8. Plat 4 has 11 1-5 pounds of Phosphoric Acid and 20 pounds of Potash, while plat 8 has 13.6 pounds of Phosphoric acid, yet plat 8 produces a little more than 9.5% more grain, and 40% more straw than plat 4.

Now let us compare plats 2 and 7. Plat 2 with 12½ pounds of Potash and 10.8 pounds of Nitrogen produces 19% (omitting decimals) more straw than grain, while plat 7 with 20 pounds of Potash and 4.8 pounds of Nitrogen produces nearly 26% more straw than grain, and also produces about 62% more grain and over 71% more straw than plat 2. By an examination of Table A., it will be found that plat 2 is the only plat which falls below the average yield of the unfertilized plats: Did the diminution of the amount of potash and the more than doubling of the amount of nitrogen applied to plat No. 2 cause this decrease in yield? The

results secured on plat 7 seem to answer this question in the affirmative. Here we increase the potash 60%, and diminish the nitrogen 55½%, and secure an increased yield of both grain and straw, making a difference in the yield of the two plats of 147¾ pounds of grain, and 204¾ pounds of straw. The results secured in the experiment in Roane county (table D) confirm this theory, but the results secured in Wood and Doddridge counties contradict it.

At all of the Out-Stations upon the plats treated with commercial fertilizers, plats 5 produce the largest yield of both grain and straw, with the two exceptions of the production of straw, in Wood and Marshall counties. The abnormal yield of both grain and straw on plat 10 in Marshall county (table A) has already been referred to. This plat lies on the hillside below the other plats, occupying the comparatively flat part of a terrace of the hill. Immediately below it is a fence of long standing dividing the field containing the experiment grounds from other fields on the farm. It also being a favorable location for the rest and rumination of cattle feeding in that field, the land had become exceedingly fertile from the droppings of the cattle, which contributed, no doubt, very largely to the immense growth of straw. Besides, the chickens from an adjacent farm house were very frequent visitors to this plat during the ripening and harvesting period, and consumed a large quantity of the grain. For these reasons, we will exclude Plat 10, Table A, from all calculations in considering the results of these experiments.

Upon these plats (No. 5) we used ordinary "complete fertilizer" both in composition and quantity, except that the phosphoric acid was almost doubled.

On plat 5, tables A. & B., we used 5.5 pounds nitrogen, 23.2 pounds of phosphoric acid and 20 pounds of potash. On plats 5 in tables C. & D., we used 5.76 pounds of nitrogen, 24.28 pounds of phosphoric acid and 20 pounds of potash, the amount of fertilizing elements being practically the same on each plat.

By a comparison of plats 5 in the several tables, we find a large variation in the yield of both grain and straw produced by the application of fertilizers under this formula, the yield of grain being the least (10 pounds) in Doddridge county, and the greatest (10 bushels and 12 pounds) in Marshall county. Taking the unfertilized plats as a basis, the fertilizers applied to plats 5 produced an increased yield in Marshall county of 56%; in Doddridge county nine tenths of one per cent; in Wood county of 42%, and in Roane county of 216%.

Judging from its appearance, which is partly confirmed by an analysis made of the soils at the several Out-Stations by the Chemist of this Station, the natural fertility of the soils in these several plats decreases in the following order: Marshall, Wood, Doddridge and Roane, and although three of these plats in Marshall county produced a greater yield than any of the plats in Wood county, yet the general average yield of the Wood county plats is greater than that of the Marshall county plats. It will also be ob-

served that the greatest percentage of increased yield was on the poorest plats (in Roane county, table D.) and the least, on the next poorest (in Doddridge county, table B.) This presents the very interesting question upon which there seems to be a great diversity of opinion as to the relative effects of commercial fertilizers upon poor and rich soils. These experiments give us no solution of this problem, and we are compelled to pursue other lines of investigation to discover the truth. I have no doubt that the presence or absence of humus in the soil has very much to do with these variable results. I call attention to plat 11 in table B Here, by the application of stable manure, at the rate of 16 tons per acre, where all the commercial fertilizers, whether applied singly or combined, had failed to produce any substantial effect we secure an increased yield of five bushels and thirty-two pounds per acre, taking plat 1 as the basis of the calculations, or taking a general average of all the plats as the basis, we have an increased yield of six bushels and twenty-six pounds, or an increased yield of over 36%.

It is interesting to note the variations in the yield of the several plats in these tables. Comparing the yield of these plats with each other in the order named plats 2, tables A and B, show a decrease from plats 1, while in the tables C. and D, they show an increase. Plats 3 in all the tables, show an increase over plats 2 Plats 4 in tables A, B and C, shows a decrease from plats 3, while in table D, it shows an increase. Plats 5 in all the tables shows an increase over plat 4, and further shows an increase over all other plats, except in table B. Plat 7 in all the tables shows a decrease from plat 5. Plat 8 in table A shows less than one per cent. decrease from plat 7, and in table C shows about 12% decrease, while in table B it shows an increase of over 16%, and in table D, it shows an increase of over 40%. From plats 8 to 9. we have a very large decrease in all the tables except table C, which shows an increase of about 6%, and the decrease continues in all the tables from plats 8 to 9 and from 9 to 10.

To what extent the fertilizers are responsible for these variations, it is difficult to determine. That the natural fertility and conditions of the soil have a very decided influence upon the action of the fertilizers applied, and the growth and fruitage of the plant, there can be no doubt. To enable us to secure satisfactory results in these experiments, it is necessary that we should have a uniform soil for each series of plats. The conditions of moisture and solidity, the elements from which the soil is made, the amount of humus, and all the elements of plant food contained therein, should be the same in each plat of a series. Practically, we find it almost impossible to secure land of this character, especially among the hills of West Virginia. As a consequence, there must be a certain degree of inaccuracy in all our experiments in fertilization, and soil testing by growing plants.

In looking over these tables, we find that while in most cases there is a very gratifying increase in the yield, yet there are very few plats which have paid back the investments made.

Whether the continued effect of these fertilizers for a period of years, without any additional artificial fertilization would produce an increased yield in the crops sufficient to repay the investment and leave a surplus, is a question which we have not yet determined, as this is the first year of our experiment on these plats.

CONCLUSIONS.

From these experiments we draw the following conclusions:

First: —That it is not profitable to use nitrogenous fertilizers in large quantities, or use them in ordinary quantities alone as fertilizers for growing wheat. (See Plats 2 and 10.)

Second: —That the combination of Potash, Nitrogen and Phosphoric Acid, produces the largest yield. (See Plats 3 and 5)

Third: —That Phosphoric Acid alone produces very satisfactory results. (See Plats 8.)

Fourth: —That probably the most profitable application of Commercial Fertilizers would be Potash, in the form of Kainit and Phosphoric Acid, in the form of South Carolina Dissolved Bone (S. C. Rock.)

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Bulletin No. 26.

WEST VIRGINIA

Agricultural Experiment Station,

MORGANTOWN, W. VA.

LAW AND REGULATIONS CONCERNING THE SALE OF COMMERCIAL FERTILIZERS IN THE STATE OF WEST VIRGINIA. ANALYSES.

SEPTEMBER, 1892.

JOHN A. MYERS, Director.

CHARLESTON, W. VA.
MOSES W. DONNALLY, PUBLIC PRINTER,
1892.

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SUSIE V. MAYERS, ; . Stenographer and Book-keeper.

INSPECTION OF COMMERCIAL FERTILIZERS.

The law regulating the inspection and sale of fertilizers in West Virginia does not appear to be fully understood by manufactures and others. There are so many misapprehensions upon the subject that I deem it advisable to print the law in full together with our arrangements for conducting the analytical work and inspection.

LAW.

AN ACT concerning Commercial Fertilizers, and repealing chapter twenty five of the Acts of the Legislature of West Virginia of 1879. (Chap. LXXII.)

[Passed March 6, 1891.]

Be it enacted by the Legislature of West Virginia:

1. Every person or company who shall sell, offer or expose for sale, in this State, any commercial fertilizer or manure, shall affix conspicuously to every package thereof a plainly printed statement, clearly and truly certifying the number of net pounds of fertilizer in the package, name, brand, or trade mark under which the fertilizer is sold, the name and address of the manufacturer, the place of manufacture, and a chemical analysis, stating the percentage of nitrogen or its equivalant in amonia, of potash soluble in distilled water, and of phosphoric acid in available form, soluble in distilled water, and reverted, as well as the total phosphoric acid. In the case of those fertilizers which consist of other cheaper materials, said labels shall give a correct general statement of the composition and ingredients of the elements relied upon, contained in the fertilizer which it accompanies. If any such fertilizer be sold in bulk, such printed statement shall accompany and go with every lot and parcel sold, offered or exposed for sale.

2. Before any commercial fertilizer is sold, offered or exposed for sale in this State, the manufacturer, importer or party who causes it to be sold, exposed or offered for sale, shall file with the Director of the West Virginia Agricultural Experiment Station a certified copy of the statement named in section one of this Act,

and shall also deposit with said Director, a sealed glass jar or bottle, or sealed tin can, containing not less than one pound of fertilizer named and described in said statement, accompanied by an affidavit that it is a fair average sample thereof. The making of any affidavit required by this chapter falsely, shall be perjury.

3. The manufacturer, importer, agent or seller of any brand of commercial fertilizer or material used for manurial purposes, shall pay for each brand at the time he files the statement required in section one of this Act, an analysis fee of five dollars for each of the fertilizing ingredients claimed to exist in each and every brand as fertilizer which he sells, offers or exposes for sale within this State, provided that whenever the manufacturer or importer shall have paid the analysis fee herein required for any particular brand of fertilizer, no agent or seller shall be required to pay any other or further analysis fee for said brand.

4. The analysis fee required to be paid by section three of this act shall be paid to the Treasurer of the West Virginia University for the use of the Agricultural Experiment Station, and the party making such payment shall take from said Treasurer triplicate receipts therefor, one of which he shall retain and the other shall be deposited, one with the Director of the Agricultural Experiment Station, and the other with the Secretary of the Board of Regents of the West Virginia University, and by them filed and preserved in their respective offices.

5. Immediately after the filing of the receipt aforesaid with the Director of the Agricultural Experiment Station, said Director shall issue a certificate to the party making such payment, stating the amount of fees paid, and the name, brand or trade-mark under which the fertilizer is sold, the name and address of the manufacturer or importer, the place of manufacture, the name and place of business of the dealer, and the chemical analysis as set forth in the statement by section one of this act, and that the applicant for said certificate is authorized to sell said fertilizer within the State of West Virginia for the period of one year from the first day of January to the 31st day of December, inclusive. Said certificate may be issued at any time for and during the current year, and may be issued during the month of December for the year commencing on the first day of January thereafter.

6. It shall be the duty of the Director of the West Virginia Agricultural Experiment Station to make or cause to be made a chemical analysis of every sample of commercial fertilizer so furnished him, and he shall print the result of such analyses in the form of a label or tag. Such printed label or tag shall set forth the name of the manufacturer, the place of manufacture, the brand of the fertilizer, and the essential ingredients contained in said fertilizer, expressed in terms and manner approved by the Director, together with a certificate from the Director, setting forth that said analysis is a true and complete analysis of the sample furnished him of such brand of fertilizer of the ingredients claimed to be contained therein. And he shall also place upon each label or tag the money value

per ton of such fertilizer, computed from its composition, as he may determine. The Director shall furnish such labels or tags in quantities of one hundred, or multiples thereof, to any person or company complying with this act, and desiring to sell, offer or expose for sale, any commercial fertilizer in this State, and shall receive therefor the sum of fifty cents for every one hundred so delivered, and shall without delay pay the same to the Treasurer of the West Virginia University, for the use of the Agricultural Experiment Station, and take duplicate receipts therefor, one of which he shall retain and the other he shall deliver to the Secretary of the Board of Regents, who shall file and preserve the same in his office.

7. The Board of Regents of the West Virginia University shall expend the money received under the provisions of this act in meeting the legitimate expenses of the Station, in making analyses of fertilizers, in experimental tests of same, and in such other experimental work and purchases as shall inure to the benefit of the farmers of this State, and shall include in their annual report a statement of the receipts and disbursements thereof.

8. The Director of said Experiment Station is hereby authorized in person or by deputy to take samples for analysis from any lot or from any commercial fertilizer which may be in the possession of any dealer in this State. And he is hereby authorized to prescribe and enforce such rules and regulations as he may deem necessary to carry fully into effect the true intent and meaning of this act; and any agriculturalist, a purchaser of any commercial fertilizer in this State, may take a sample of the same under the rules and regulations of the Director of the said Experimental Station, and forward the same to the Experimental Station for analysis, and if the Director has reason to believe that the manufacturer of, or dealer in, said fertilizer has made any false or fraudulent representation in regard to said fertilizer, he shall cause the said sample to be analysed free of charge, and certify the same to the person forwarding the sample.

9. Said Director shall also publish, by bulletin, the brand, name and location of the manufacturer, and chemical analyses of every fertilizer analyzed or caused to be analyzed by him. Said last publication to be made, if practicable, before the time at which said fertilizer is to be applied to the soil.

10. Any manufacturer or vendor of any chemical fertilizer who shall sell, or offer or expose for sale, any commercial fertilizer without having previously complied with the provisions of this act hereinbefore set forth, shall be deemed guilty of a misdemeanor, and upon conviction thereof, shall be fined not less than fifty nor more than five hundred dollars.

11. Any company, firm or person who shall wilfully remove from or deface or change any label, or tag, or brand affixed to any package of fertilizer under the provisions of this act, before such fertilizer has been used for manurial purposes, or who shall sell such fertilizer without such label or tag being affixed thereto at the time of sale, shall be deemed guilty of a misdemeanor, and upon conviction

"The following is the form of affidavit required under Sec. 2 of the law. Blank copies of the same will be furnished by the Director free of charge upon application.

"Manufacturers or dealers sending samples of commercial fertilizers for analysis under the "Act Concerning Commercial Fertilizers" in West Virginia, will please fill out and send with the sample the following affidavit. Addressed to Dr. John A. Myers, Morgantown, W. Va.:

I ...., of .... do hereby certify that the sample ... of the following named Commercial Fertilizer ... sent this day by .... to Dr. John A. Myers, Morgantown, W. Va., contained in ... securely labeled and securely sealed for analysis under the Act of the Legislature of West Virginia, "Concerning Commercial Fertilzers," to the best of my knowledge and belief truly and fairly represent the chemical composition of the fertilizer ..... as manufactured and offered for sale by us in the State of West Virginia. The manufacturers guarantee the following minimum analysis:

	Name and trade mark of fertilizer	Manufacturers name and address	Name and address of sender	Minimum per cent. of nitrogen guaranteed.	Minimum per cent. of soluble phosphoric acid guaranteed.	Minimum per cent. of reverted phosphoric acid guaranteed.	Minimum per cent. of available phosphoric acid guaranteed,	Minimum per cent. of total phosphoric acid guaranteed	Minimum per cent. of potash guaranteed.	Minimum net weight of package guaranteed
1										
2										
3										
4										
5										
6										
7										

Given under my hand and seal this ...... day of ...., 189.... *Signed..............................*

I, ... a Notary Public within and for the county of .... State of .... do hereby certify that the above statement was sworn to before me by .... of .... on this .... day of .... 189 .....

Given under my hand and official seal as Notary Public, this .... day of ...., 1891.

NOTARY SEAL ....

Notary Public

thereof, shall be fined not less than ten nor more than fifty dollars for each offense.

12. Any company, firm or person who shall remove from or cause to be removed from any package of commercial fertilizer, any statement, label or tag affixed thereto under the provisions of this act, and affix or cause the same to be affixed to any other package of commercial fertilizer, shall be deemed guilty of a misdemeanor, and upon conviction thereof, shall be fined not less than ten nor more than fifty dollars for each offense.

13. Any company, firm or person violating any of the provisions of this act, or who fails to comply with the requirements of this act, shall be deemed guilty of a misdemeanor, and upon conviction thereof shall, when no other penalty is prescribed, be fined not less than ten nor more than one hundred dollars for each offense. But this act shall not be construed to apply to any one who manufactures fertilizers for his own use and not for sale.

14. The Director of said Experiment Station shall report to the prosecuting attorney of the county wherein the offense was committed, all violations of the provisions of this act, and failure to comply therewith, and a copy of any statement, label or tag required to be filed with said Director or prepared by him, and any analysis made or caused to be made by him, when duly certified by said Director, shall be received in evidence in any prosecution of a suit for any violation of the provisions of this act.

15. That chapter 25 of the Acts of the Legislature of West Virginia, passed on the 4th day of March, 1879, entitled "An act to protect the purchasers of fertilizers in this State," be and the same is hereby repealed.

REGULATIONS FOR FARMERS.

The following blank is supplied to farmers, free of charge, who may wish to submit samples under section 8 of this Act:

Farmers sending samples of fertilizers for analysis under the Act of the Legislature of West Virginia, passed March 6th, 1891, will please fill out and send the following blank by mail to Dr. John A. Myers, Morgantown, W. Va.:

I hereby certify that the sample of fertilizer known and sold as

....
(Name of Brand.)

was bought by me of ....
(Dealer's Name and Address.)

West Virginia ...., and that it rep-
(Date of Purchase.)

resents fairly the quality of the fertilizer as delivered to me. The fertilizer is guaranteed by the manufacturer to have the following chemical composition:

....
(Copy the Analysis.)

....

....

....

....

It is sold at $...... per ton cash or $...... per ton upon time. The Director's tag taken from one of the packages is enclosed with the sample.

Sign, ...

Date. ....189 .

Address..................

I hereby certify that I witnessed the taking of the above named sample by ...., and that I believe it represents fairly the quality of fertilizer bought by him, and sampled for analysis. I further state that I have no financial interest in the above transaction.

Sign, ...
(Name of some other Person.)

Date, ...189.., Address, ...

NOTICE.--Farmers and others in taking samples for Analysis will please follow closely the dir ctions given for sampling fertilizers."

JOHN A. MYERS, *Director.*

DIRECTIONS FOR TAKING SAMPLES OF FERTILIZERS FOR ANALYSIS.

"1st. All analytical work is based upon the supposition that the chemist recives a fair sample for analysis, and all persons should exercise special care in securing an average, fair sample, which may best be accomplished.

(*A*) *If from bulk—*

By taking a shovel or scoop full from a number of places in the pile and rapidly and thoroughly mixing these quantities together, then taking the samples from this mixed mass. The mixing may be done upon a clean floor with the shovel or scoop by repeatedly shoveling the heaps together after separating it into several parts. The whole operation should be continuous and rapid so that there will be no appreciable change of moisture. The mixing should be sufficient to cause soft or moist masses to be broken up and thoraughly inter-mixed with the body of the fertilizer, but care should be observed not to pulverize hard dry lumps so as to change the physical character of the fertilizer. In other words the chemist should receive a fair sample both as to chemical and physical properties.

(*B*) *If from barrels, sacks or packages.*

By opening the sack, barrel or package and thoroughly mixing the contents down to about one half of its depth by means of a shovel or scoop, then if need be withdrawing several scoops full and thoroughly mixing upon a floor exactly as under "*A.*" It is best to take scoops or shovels full from several sacks or packages and mix these as directed, then take the same for analysis from the mixed mass. Observe the conditions given under "*A.*" Fair samples are best secured from fresh packages, and *farmers will do well to draw all samples immediately after purchasing.*

2nd. Care should be observed to attend to the drawing of the sample without delay and sample should be promptly selected, labeled and shipped. In the case of a manufacturer or dealer this sample is accompanied by the affidavit required by law (see directions to manufanturers.) If the sample be sent by a farmer, for mutual protection, *it is best, though not required*, that it be drawn and sealed in the presence of a disinterested party who should join the farmer in certifying that the sample fairly represents the goods as purchased by him. In the *case of the farmer there is no charge for the analysis*, but the *express charges upon the sample should be prepaid.* Proper blanks will be provided by the Director free of charge for all farmers applying for them.

Samples received at the Experiment Station from Manufacturers will be analysed in the order received. *Manufacturers and dealers are, therefore, urged not to wait to the last moment to send in their samples, but to send them as soon as possible.*

INSTRUCTIONS TO MANUFACTURERS AND GENERAL AGENTS.

Manufacturers of Commercial Fertilizers selling their goods in this State, will please observe the following points in complying with the Act of the Legislature of West Virginia, passed March 6th, 1891, and now in force:

1st. A compliance with the law requires that before any commercial fertilizer is sold, offered or exposed for sale in this State, the manufacturer, importer or party who causes it to be sold, exposed or offered for sale shall file an affidavit with the Director of the West Virginia Agricultural Experiment Station, at Morgantown, W. Va., giving a correct statement of the net pounds in the packages, the name of the brand or trade mark under which the fertilizer is sold, the name and address of the manufacturer, the place of manufacture, and the chemical analysis stating the percentage of nitrogen, or its equivalent in ammonia, the percentage of potash soluble in distilled water, and the percentage of phosphoric acid in available form, soluble in distilled water, and reverted, as well as the total phosphoric acid. In the case of those fertilizers which consist of other cheaper materials, the affidavit shall give a correct general statement of the composition and ingredients of the elements in the fertilizer relied upon to produce fertilizing effect upon the soil.

*2d. The manufacturer is required to send with the affidavit a fair sample of the fertilizer in a sealed jar, bottle or tin can for analysis. An ordinary quart fruit jar or can filled with a fair sample of the fertilizer will answer. Each can or jar should be properly sealed, labeled and packed, and shipped prepaid by express to Dr. John A. Myers, Morgantown, W. Va.

3d. The manufacturer is required to pay at the time of filing the affidavit an analysis fee of $10 for each and every fertilizing ingredient claimed by him. If he claims potash, phosphoric acid and nitrogen, it is $10 for each, or $30 for a complete fertilizer, consisting of all three of the above named elements of plant food. This fee should be sent in a draft upon New York or Baltimore, payable to "The Treasurer of the West Virginia University."

4th. The manufacturer is required to place a label or tag upon each package, giving the name of the brand, its correct net weight, analysis and commercial valuation per ton. These labels are provided only by the Director of the West Virginia Agricultural Experiment Station, after analyzing the fertilizer, are regularly numbered and can only be had by the parties filing the affidavit before mentioned. The law establishes the price at 50 cents per 100

*Manufacturers will please keep a sample of the same lot for analysis by their own chemist.

labels or tags. Manufacturers requiring these tags or labels should indicate to the Director the number of each kind required, and send a check payable to John A. Myers, Director, for the amount. They will be sold in packages of 100 each, and manufacturers will please order by even hundreds.

5th. *The fertilizer inspection begins with January 1st of each year, and the manufacturers should comply with the law promptly at that time.* By doing so they give the chemist time to analyze the samples before the trade for the spring opens, and the results can be published for the spring trade.

Manufacturers and agents will therefore please to take immediate steps to comply with the above indicated provisions, which are intended to guide them. The Director will furnish the necessary blanks for complying with the law, free of charge, and will aid the manufacturers in any way in his power to comply with its requirements. All affidavits and applications for labels should be filed as soon as possible.

Address all communications to

DR. JOHN A. MYERS,
Morgantown, W. Va.

VALUATIONS FOR 1892.

The commercial valuation of fertilizers is based upon the average retail price of the ingredients from which they are compounded. We are aware of the fact that there are sometimes sudden fluctuations in the prices due to speculation, variations in the supply and demand, etc., but we are confident that the valuation given below should fairly represent the average price at which the fertilizers may be retailed in this State. *By proper negotiations in many cases where favorable freight rates prevail, the fertilizer may be bought for less than these prices.*

TRADE VALUES OF FERTILIZING INGREDIENTS IN RAW MATERIALS AND CHEMICALS FOR 1892.

Nitrogen In Ammonia Salts,	19c.
" In Nitrates	17c.
Organic Nitrogen In dry and fine ground fish meat and blood,	19c.
In cottonseed meal and castor pumice,	15c.
In fine bone and tankage,	16½c.
In fine medium bone and tankage,	13c.
In medium bone and tankage,	10½c.
In coarse bone and tankage,	8½c.
In hair, horn shavings and coarse fish scrap,	8c.
Phosphoric acid soluble in water,	8c.
Soluble in citrate of ammonia (reverted),	8c.
In ground fish, fine bone and tankage,	7c.
In fine medium bone and tankage,	6c.

In medium bone and takage,	5c.
In coarse bone and tankage,	4c.
In fine ground rock Phosphate,	2c.
Potash as high grade sulphate and in forms free from Muriates (or chlorides),	6c.
As Kainite,	5c.
As Muriate,	5c.

TRADE VALUE OF MIXED FERTILIZERS AND SUPERPHOSPHATES OF HIGH GRADE.

Nitrogen	19c.
Available Phosphoric Acid	8c.
Insoluble Phosphoric Acid	3c.
Potash	5c.
Phosphoric Acid in fine ground bone, i e. passes through 1-25 inch mesh sieve,	4½c.
Phosphoric Acid in medium ground bone, i. e. passes through 1-16 inch mesh sieve, but not through 1-25 inch mesh sieve,	4c.

The commercial value of a fertilizer is found by multiplying the number of pounds of each ingredient per ton as shown by analysis by the price of each, and taking the sum of these products, For example we have the following analysis :

Moisture	11.50	per	cent.
Soluble phos. Acid.	9.00	"	"
Reverted " "	2.50	"	"
Available " "	11.50	"	"
Insoluble " "	1.00	"	"
Total " "	12.50	"	"
Nitrogen	2.00	"	"
Potash	3.00	"	"

Available Phosphoric Acid	11.50x20x8–	$18.40.
Insoluble " "	1.00x20x3–	0.60.
Nitrogen	2.00x20x19–	7.60.
Potash	3.00x20x5–	3.00.
Commercial value per ton		$29.60.

This does not represent the Agricultural value of the fertilizer, which depends upon the crop, soil, weather, etc., as well as upon the character and amounts of the ingredients.

With January 1st, 1893, a new table of valuation will be adopted. Owing to the fluctuations in the price of Phosphate the valuation of phosphoric acid appears to be too high, and the valuation of nitrogen is lower than the apparent ruling prices in ammoniated fertilizers.

The following analyses giving the composition of the various brands of fertilizers were made by Dr. de Roode, chemist to the Station. There has been a marked improvement in the guarantees of the manufacturers. Last year twenty seven per cent. of the brands of fertilizers offered for sale in the State fell short of the

claims of the manufacturers This year it has been reduced to thirteen per cent., much too large a proportion, it is true, but commendable progress has been made. It appears this year to be quite evident that the majority of cases of excessive claims is probably due to irregular mixing of the goods, and not due to a shortage of ingredients actually supplied by the manufacturers

The analyses of the samples sent in by the farmers and collected by the agents of the Station at various points in the State, indicate that there is a general effort upon the part of the fertilizer trade to comply very strictly with the provisions of the law which appear to be generally satisfactory to the farmers. The manufacturers now understand their duties quite clearly and the farmers are freely availing themselves of its provisions. The agents over the State generally are exercising care to see that the manufacturers maintain the quality of their goods, and it is doubtful whether the provisions of the law can be much improved upon.

The following table shows the analysis and relative valuation of the various brands of fertilizers sold in the State for the year beginning with Jan. 1, 1892 and extending to Sept. 1, 1892 :

Name of Brand.	Name and Address of Manufacturers or General Agents.	Analysis of Samples Sent by Manufacturers. Total Phos. Acid per ct	Sol. phos. acid pr ct	Rev. phos acid pr ct	Av' phos. acid pr ct	Insol. ph. acid pr ct	Nitrogen, per cent.	Potash, per cent.	Valuat'n per ton.	Guarantee of Manufacturers Valuat'n per ton.	T't'l ph's. acid pr ct	Av' phos. acid pr ct	Nitrogen, per cent.	Potash per cent.	Ex. of val. by anal	Def. val. by anal.
Star Brand Guano	Allison & Addison, Richmond, Va.	10.66	7.18	1.71	8.89	1.77	2.02	1.21	$21 17	$20 92	9.00	8.00	1.65	1.25	$3.25	$...
Star Brand Tobacco Manure	" " " "	10.13	7.97	1.81	9.78	.65	2.72	1.16	27 83	21 83	10.00	9.00	2.26	1.25	3.00	...
Anchor Brand Tobacco Fertilizer	" " " "	12.36	7.61	1.91	9.52	2.84	3.14	1.56	30 42	25 98	11.00	8.50	2.47	10.50	4.44	....
Acid Phosphate	" " " "	14.06	9.38	3.09	12.47	1.59	....	.....	20 91	19 20	12.00	12.00	....	.....	1.71	...
Double Superphosphate	American Phos. & Chem. Co., Balto	42.24	34.61	6.93	41.54	.70	....	.....	66 88	64 60	41.00	40.00	...	.....	2.28	...
Acid Phosphate or Diss. S. C. Rock	Baugh & Sons Co., Baltimore, Md	15.31	12.32	1.54	13.86	1.45	....	.....	23 05	20 80	.....	13.00	...	.....	2.25	...
Pure Raw Bone Meal	" " " " "	22.41	.....	.....	.....	....	4.07	.....	33 60	32 10	21.00	....	4.09	.....	1.50	...
Double Eagle Phosphate	" " " "	12.12	6.38	3.02	9.40	2.72	2.23	.....	25 15	19 70	10.00	8.00	1.50	.....	5.45	...
High Grade Superph'sph'te of Bone	Blecher & Co., Gettysburg, Pa.	13.97	8.50	4.18	12.68	1.29	.90	1.04	25 52	20 25	10.00	8.00	1.25	1.50	5.27	..
Soluble Am. Bone Phosphate	" " " "	9.71	5.82	2.77	8.59	1.12	.38	1.30	17 16	15 20	8.00	7.00	.50	1.50	1.96	...
Bowker's Superphosphate	Bowker Fertilizing Co., Bost'n, Mass	14.01	9.06	2.82	11.88	2.13	....	.....	20 28	18 80	13.00	11.00	....	.....	1.48	...
Fresh Ground Bone	" " " " "	18.49	4.28	11.75	16.03	2.47	3.37	.	39 [illegible]	37 35	18.00	...	2.25	.....	2.57	...
Pure Acidulated Bone	Cin'ti Dessicating Co., Cincin'ti, O	17.36	1.67	7.59	9.26	8.10	3.99	.....	34 83	33 50	17.00	10.00	3.50	.....	1.33	....
Gilead Phosphate	" " " " "	13.40	2.65	7.39	10.04	3.36	2.95	1.74	31 03	31 99	12.00	10.00	3.30	2.25	....	.96
Ohio Valley Phosphate	" " " " "	10.90	2.88	6.17	8.05	2.85	1.90	2.52	24 33	22 27	10.00	8.00	1.65	2.00	2.06	....
Phoenix Phosphate	" " " " "	10.46	4.16	4.93	9.09	1.37	2.31	1.12	25 26	21 43	9.00	8.00	1.85	1.00	3.83	...
Pure Raw Bone Meal	" " " " "	24.67	.....	.....	.....	....	3.90	.....	38 59	37 04	21.00	....	1.32	.....	1.51	...
Fine Ground Bone	" " " " "	21.42	.....	.....	.....	....	3.38	.....	33 47	31 86	20 00	....	3.30	.....	1.61	...
XXX Phosphate	Cleveland Dryer Co., Cleveland, O	15.31	10.80	1.82	12.62	2.69	....	.....	21 80	22 00	15.00	13.00	....	.....	.....	.20
Superior Bone	" " " " "	23.04	.....	.....	.....	....	4.54	.....	32 57	29 79	22.00	.....	3.71	.....	2.78	..
Square Bone	" " " " "	15.42	3.05	9.83	12.88	2.54	2.65	.....	33 73	27 38	20.00	6.00	2.47	.....	6.35	...
Ohio Seed Maker	" " " " "	12.66	7.39	3.35	10.74	1.92	1.32	.....	23 35	22 47	13.00	10.00	1.23	.....	.88	...
Buckeye Am. Bone Superphos.	" " " " "	12.34	6.93	3.39	10.32	2 02	2.48	.....	27.15	24 98	11.00	9.00	2.47	...	2.17	....
Corn and Oats Fertilizer	Chesapeake Guano Co., Balto, Md.	12.16	6.57	3.95	10.52	1.64	.93	.77	22 1[illegible]	20 89	10.00	9.00	1.00	2.00	1.32	....
Dissolved Bone Phosphate	" " " " "	13.36	10.45	1.65	12.10	1.26	....	.....	20 11	22 00	15.00	13.00	....	.....	.....	1.89
Chesapeake Guano	" " " " "	12.58	7.50	2.15	9.65	2.93	1.89	.97	25 35	24 80	12.00	9.00	2.00	1.00	.55	....
Pure Dissolved S. C. Bone	Chemical Company of Canton	14.63	13.20	1.35	14.55	.08	....	.....	23 33	22 00	15.00	13.00	....	.....	1.33	....
Baker's Special Wheat, Corn and Grass Mixture	" " "	9.49	6.40	1.51	7.91	1.55	1.45	1.11	20 5[illegible]	20 26	11.00	9.00	.70	2.06	.32	...
Imperial Bone Phosphate	E'reka Fertiliz'g Co., Perryville, Md	11.65	6.52	3.06	9.58	2.07	.82	1.81	21 50	18 11	10.00	8.00	.82	1.00	3.39	...
P. & P. Superphosphate	" " " " "	12.68	9.23	2.05	11.28	1.40	.	...	18 89	22 00	15.00	13.00	...	.....	...	3 11
Corn Fertilizer	Gr'nb'r Meat & Fert. Co., Roncev'te	10.63	6.94	2.89	9.83	.80	.60	1.49	19 98	19 67	9.33	8.66	1.03	1.50	.31	....
Keystone Diss. Bone Phosphate	S. M. Hess & Co., Reading, Pa.	11.14	7.80	2.46	10.26	.88	1.23	1.58	23 20	18 85	10.00	9.00	.75	1.00	4.35	...
Emperor Phosphate	" " " " "	12.38	8.35	2.97	11.32	1.06	....	.94	19 69	20 20	12.00	12.00	....	1.00	.....	51
Farmer's Alkaline Bone	Lorentz & Ritler, Baltimore	11.98	7.95	2.32	10.27	1.71	....	2.40	19 86	18 70	12.00	10.00	....	1.50	1.16	....
Monogram Am. Bone	" " "	10.47	3.72	3.40	7.12	3.35	1.07	2.06	19 53	18 15	10.00	8.00	.83	1.00	1.38	....
Ruth's Good Luck Guano	" " "	11.69	5.80	2.82	8.62	2.93	1.82	1.81	21 30	27 00	11.25	9.25	2.50	1.50	.....	2 70
Dissolved S. C. Bone	" " "	14.95	12.52	1.76	14.18	.67	....	.....	23 25	22 00	15.00	13.00	....	.....	1.25	....
Sun Ammoniated Superphosphate	Liebig M'f'g Co., Carteret, N. J.	12.25	1.08	9.37	10.45	1.80	1.36	1.19	24 15	20 11	10.00	10.00	.82	1.00	4.04	....
High Grade Acid Phosphate	" " " " "	14.74	12.72	1.78	14.50	.24	....	.....	23 34	20 80	14.00	13.00	....	.....	1.94	....

Analysis of Samples Sent by Manufacturers. | *Guarantee of Manufacturers*

Name of Brand.	Names and Addresses of Manufacturers or General Agents.	Total Phos. Acid pr ct.	Sol. Phos. Acid per ct.	Rev. Phos. acid per ct.	Av. Phos. acid per ct.	Ins. Phos. acid per ct.	Nitrogen per ct.	Potash, per ct.	V'luation per ton	V'luation per ton	T'tl Phos. acid per ct.	Av. Phos. acid per ct.	Nitrogen per ct.	Potash, per ct.	Excess of V'luation	D'f'cy of V'luation
Dissolved S. C. Bone	Liebig M'f'g Co., Carteret, N. J.	14.9[illegible]	12.7[illegible]	1.8[illegible]	11.[illegible]	[illegible]			[illegible]	[illegible]	[illegible]	11.00			[illegible]	[illegible]
Urbana Superphosph and Potash	[illegible]udenbach Fer. Co., Urbana, O.	11.3[illegible]	7.[illegible]	2.2[illegible]	10.[illegible]	.5[illegible]	2.45	[illegible]	[illegible]	[illegible]	[illegible]	9.50	[illegible]	1.[illegible]	1 6[illegible]	
Standard Superphosphate	Lister's Agr. Ch. Wks., Balto., Md.	12.36	6.4[illegible]	[illegible]	8.70	.5[illegible]	2.1[illegible]	1.[illegible]	[illegible]	[illegible]	[illegible]	10.00	2.[illegible]	1.70	62	
Harvest Queen	" "	11.5[illegible]	6.6[illegible]	2.59	9.0[illegible]	2.5[illegible]	.0[illegible]	2.8[illegible]	[illegible]	[illegible]	[illegible]	10.00	1.0[illegible]	1.[illegible]	1 [illegible]2	
Shenandoah	W. F. & T. Lippitt	12.[illegible]	6.79	2.47	9.17	2.8[illegible]	2.31	2.[illegible]	[illegible]	21 77	10.9[illegible]	[illegible]	1.6	1.[illegible]	5 7[illegible]	
Linden Superphosphate	Md. Fer. & M'f'g Co., Balto., Md.	12.53	8.[illegible]	2.[illegible]	11.43	1.10		2.46	21 [illegible]	18 6[illegible]	11.00	10.[illegible]		2.60	2 80	
Ammoniated Bone	" "	12.39	5.74	2.68	[illegible]	2.90	2.05	1.61	[illegible]	23 [illegible]	10.00	9.00	1.[illegible]	1.50	1 71	
Globe Complete Manure	" "	11.11	6.6[illegible]	1.64	8.[illegible]	2.11	1.6[illegible]	2.[illegible]	23 [illegible]	21 9[illegible]	1[illegible]	9.00	1.1[illegible]	1.50	1 62	
Tornado Fertilizer	" "	12.35	9.01	2.3[illegible]	11.3[illegible]	.97	.61	3.[illegible]	[illegible]	[illegible]	12.[illegible]	11.[illegible]	.[illegible]	[illegible]	1 89	
Dissolved Phosphate	" "	14.81	12.1[illegible]	1.3[illegible]	13.[illegible]	1.3[illegible]			[illegible]	21 [illegible]	11.00	1[illegible].00				1 05
P. G. Am. Superphosphate	Mt. Airy Manuf'g Co. "	10.82	5.92	2.39	9.31	1.51	1.2[illegible]	1.[illegible]	2[illegible]	18 7[illegible]	[illegible]	[illegible]	1.[illegible]	1.0[illegible]	2 8[illegible]	
Piedmont Raw Bone Mixture	" "	10.1[illegible]	5.39	2.91	[illegible]	1.[illegible]	[illegible]	1.5[illegible]	1[illegible]	1[illegible]		7.00	.8[illegible]	1.00	1 21	
Piedmont Diss. Bone Phosphate	" "	12.65	7.[illegible]	3.9[illegible]	11.5[illegible]	.[illegible]9		1.[illegible]	19	1[illegible]		10.70		1.0[illegible]	2 [illegible]2	
Wheat, Oats and Barley Mixture	Milsom R'nd'g & F. Co. Buffalo, N. Y.	11.6[illegible]	9.1[illegible]	2.2[illegible]	[illegible]	2.0[illegible]	[illegible]	3.[illegible]	31 [illegible]	23 6[illegible]	10.0[illegible]	[illegible]	2.00	2.0[illegible]	[illegible] 7[illegible]	
Horse-shoe Brand Garden City Phos.	North Western F. Co., Chicago, Ill.	13.29	3.63	7.[illegible]	11.[illegible]	1.70	[illegible]	1.0[illegible]	31 0[illegible]	[illegible]	1[illegible].00	8.00	[illegible]	.51	3 11	
Fine Raw Bone	" " "	21.59	.....	.....	.....	.....	4.04	.....	36 41	34 91	22.00	.....	3.29	.....	1 47	....
H. S. B. Prairie Phosphate	" " "	11.95	2.7[illegible]	5.21	8.0[illegible]	.9[illegible]	2.0[illegible]		22 8[illegible]	17.63	9.00	6.00	.64		5 25	
Sol. Ammon. Superphos. Bone	G. Ober & Sons Co., Balto., Md.	11.68	7.12	2.11	9.[illegible]	2.[illegible]	2.25	2.7[illegible]	27 [illegible]	2[illegible] 97	10.00	8.[illegible]	1.9[illegible]	1.7[illegible]	3 61	
Farmers' Standard Am't Phosph.	" "	11.2[illegible]	7.37	2.65	10.0[illegible]	1.[illegible]5	1.[illegible]6	2.21	26 17	22 1[illegible]	10.00	8.[illegible]	1.75	1.7[illegible]	4 22	
Ober's Shawnee Am't Phosphate	" "	11.7[illegible]	7.[illegible]	2.64	10.[illegible]	1.51	1.5[illegible]	3.[illegible]	25 7[illegible]	22 15	10.00	8.00	1.75	1.[illegible]	3 62	
Ober's Diss. Bone Phosphate S. C.	" "	15.10	12.17	4.33	1[illegible].50	.96			2[illegible] 7[illegible]	22 0[illegible]	1[illegible].00	12.00			1 [illegible]	
Red Bag Fertilizer	W. S. Powell & Co. "	11.[illegible]6	8.61	2.[illegible]	11.03	.42	2.22	2.1[illegible]	[illegible]	21 67	[illegible].00	8.00	1.65	2.00	6 55	
Dissolved S. C. Bone	" "	13.78	11.70	1.61	13.31	.47			21 5[illegible]	20 30	1[illegible].00	12.00			7[illegible]	
Bone and Potash	" "	13.38	10.95	1.48	12.43	.9[illegible]	...	1.81	22 [illegible]	17 [illegible]	10.00	9.00	...	2.00	5 27	
Excelsior Plant Food	Ramsberg Fertil. Co. "	11.28	7.41	2.66	10.07	1.21	2.01	.87	2[illegible] 3[illegible]	2[illegible] 30	12.00	9.00	2.60	.50	1 04	
Dissolved Bone Superphosphate	" "	15.92	9.41	3.60	13.0[illegible]	2.88	...		22 59	20 1[illegible]	11.00	12.00			2 19	
Walker's Dissolved S. C. Phosph	Raisin Fertilizer Co. "	15.64	12.12	3.02	15.14	.5[illegible]	.	.	24 [illegible]	23 00	15.00	14.00	.		1 22	
Empire Guano	" "	11.90	6.17	1.90	8.07	3.[illegible]	2.33	2.06	2[illegible] 12	2[illegible] 35	10.00	9.00	2.[illegible]	1.75	1 77	
Dissolved Bone	" "	14.91	8.54	2.62	11.16	3.7[illegible]	2.11		2[illegible] 12	21 2[illegible]	11.00	10.00	2.00	.	3 92	
Acid Phosph. or Diss. S. C. Phos.	" "	15.72	11.94	3.05	14.99	.73	..	.	2[illegible] 42	2[illegible] 00	15.00	1[illegible].00	.	.	1 42	
Dissolved South Carolina	Slingluff & Co. "	13.26	10.02	2.09	12.11	1.15	....	..	2[illegible] 07	20 80	1[illegible].00	13.00		...	.	73
Dissolved S. C. Bone	Susquehanna Fer. Co. "	15.32	12.16	2.25	14.41	.91	..	...	23 60	22 00	15.00	12.00		.	1 6[illegible]	
Miller's Standard Am. Bone Phos.	" " "	10.37	6.19	2.34	8.76	1.61	1.21	1.37	20 95	19 16	10.00	8.00	1.03	1.25	1 79	
National Tobacco Fertilizer	S. W. Travers & Co., Richmond, Va.	10.93	6.75	2.52	9.27	1.66	2.16	2.43	26 46	24 08	10.50	8.50	1.85	2.25	2 38	
"B. B. B." Beef Blood and Bone	" " "	10.88	6.84	2.52	9.36	1.52	1.76	1.65	24 23	20 67	9.00	8.00	1.65	1.00	3 56	
Standard Acid Phosphate	" " "	15.02	12.84	1.97	14.81	.21	....	..	23 82	21 40	14.00	13.00	.	....	2 42	
Capital Dissolved S. C. Bone	" " "	12.23	6.53	4.19	10.72	1.51	....	.....	18 06	17 2[illegible]	12.00	10.00	....	....	86	
Tinsley's Ammoniated Bone	Jas. G. Tinsley & Co. "	12.78	8.07	2.81	10.88	1.90	1.05	.....	22 54	19 04	...	10.0.	.80	.....	3 50	
Tinsley's Dissolved S. C. Bone	" " "	15.53	11.79	1.68	13.47	2.06	....	....	22 79	20 80	.....	13.00	....	....	1 99	
Farmers' Choice	I. P. Thomas & Son Co., Philadel.	11.52	7.26	2 58	9.84	1.68	1.63	2.11	25 06	22 97	10.00	9.50	1.44	2.00	2 09	

Analysis of Samples Sent by Manufacturers. | *Guarantee of Manufacturers.*

Name of Brand.	Names and Addresses of Manufacturers or General Agents.	Total Phos. Acid pr.ct	Sol. phos acid, pr. ct	Rev. phos acid, pr. ct	Av' phos. acid, pr. ct	Insol. ph. acid, pr. ct	Nitrogen, per cent.	Potash, per cent.	Valuat'n per ton.	Valuat'n per ton.	T'l phos acid, pr. ct.	Av' phos. acid, pr. ct.	Nitrogen, per cent.	Potash, per cent.	Ex. of val. by anal.	Def. val. by anal.
Norman Bone Phosphate	I. P. Thomas & Son Co., Philadel.	9.87	6.44	2.58	9.02	.85	1.38	2.02	$22 21	$19 61	9.50	8.50	1.03	1.50	$2 60	$
Improved	"	13.55	8.77	3.79	12.56	.99	.60	....	22 97	19 76	12.00	11.00	.41	....	3 21	....
S. C. Phosphate	" " " "	15.33	11.24	3.24	14.48	.85	...	.....	23 68	21 40	14.00	13.00	....	....	2 23	....
Pure Ground Bone	" " " "	25.58	.....	.....	.....	....	3.95	.....	39 61	36 28	23.00	.....	3.71		3 33	
A. B. Phosphate	Washington & Alexander, Charlestown, W. Va	10.91	3.32	3.43	6.75	4.16	1.39	3.36	21 96	19 00	9.50	7.50	1.00	2.00	2 96	
Big Bonanza	Walker, Stratman & Co., Pittsburg	11.64	4.28	5.29	9.57	2.07	2.53	1.30	27 46	27 70	12.00	10.00	2.50	1.00		24
Flour Feed	" " " "	9.92	2.52	3.93	6.45	3.47	1.70	.96	18 20	19 25	10.00	8.00	1.25	.50	.....	95
Pure Raw Bone	" " " "	25.07	.....	.....	.....	....	3.73	.....	39 78	36 80	22.00	.....	4.00	.....	2 98	....
Helpmate	" " " "	15.24	7.49	5.49	12.98	2.26	....	.....	22 12	20 40	14.00	12.00	....	.....	1 72	....
Butcher's Ground Bone	" " " "	15.32	.....	.....	.....	....	3.03	.....	31 45	24 55	16.00	.....	2.06	.....	6 90	....
XX Acid Phosphate	Walton & Whann Co., Wilm'n, Del	18.12	13.50	1.51	15.01	3.08			25 91	23 40	13.00	13.50	.		2 81	.
Wheat and Grass Grower	" " " "	13.55	6.94	5.52	12.46	1.09	1.00		24 39	21 21	13.00	11.00	.80		3 15	.
Dissolved Bone Phosphate	"	14.37	8.22	4.57	12.79	1.58			21 41	20 40	14.00	12.00			1 09	
Dissolved S. C. Bone	The Zell Guano Co., Baltimore, Md	15.65	13.71	1.45	15.16	.49			21 57	22 30		14.00			2 17	
Special Compound for Tobacco	" "	11.78	6.81	2.12	8.93	2.85	1.86	1.51	24 57	21 27	10.00	8.00	1.65	1.00	3 30	
Economizer	" " "	12.62	8.05	2.68	10.73	1.89	1.13	1.17	21 07	19 72	11.00	9.00	.82	1.00	4 35	....
Calvert Guano	" " " " "	12.54	8.24	2.76	11.00	1.54	.87	1.90	23 73	18 95	11.00	9.00	.62	1.00	4 78	....
Dissolved Bone Phosphate	" " " " "	14.92	13.13	1.51	14.64	.28			23 59	22 00	15.00	13.00			1 59	
Special Mixture for Wheat	W. F. & T. P. Lippitt	11.11	8.00	1.81	9.81	1.30	1.47	1.33	23 51	16 17	8.00	7.00	.82	1.25	7 34	
B. G. Ammoniated Bone	The Baltimore Guano Co.	10.82	3.35	4.87	8.22	2.60	1.45	1.86	22 00	20 67	10.00	8.00	1.23	2.00	1 33	
Defiance Bone	" "	13.03	2.44	7.95	10.39	2.64		4.32	22 52	20 80	13.00	11.00	..	2.00	1 72	.
Baltimore Soluble Bone	" " " "	13.78	2.34	9.45	11.79	1.99	....	.....	20 05	22 00	15.00	13.00	..			1 95
Americus Amm'd Bone Superphosphate	Williams & Clark Fertilizer Co	10.30	6.51	3.44	9.95	.35	2.56	1.98	27 83	26 38	10.00	9.00	2.47	2.00	1 45	
Royal Bone Superphosphate	" " " "	9.25	4.24	3.75	7.99	1.26	1.25	2.24	20 53	17 71	8.00	7.00	1.03	2.00	2 82	.
Pure Bone Meal	" "	18.87					3.78		35 11	32 15	20.00		2.47		2 96	
Acorn Brand Acid Phosphate	" "	13.32	7.59	3.90	11.49	1.83	..		19 48	19 80	13.00	12.00				32
Lister's Celebrated Ground Bone	Lister's Agricultural Chem. Works	15.04					3.96		34 71	29 38	12.00	12.00	2.68		5 36	.
Lister's U. S. Phosphate	" " " "	8.50	1.65	4.65	6.30	2.20	1.52	1.58	18 75	18 82	8.00	7.10	1.32	2.00		
Baugh's Pure Dis. Animal Bone	Baugh & Sons Co	20.48	2.20	14.39	16.59	3.89	3.00	....	40 27			11.00	2.50	...		
Special Mixture for Wheat	G. Ober & Sons Co.	11.02	5.16	1.94	7.10	3.92	1.40	1.83	21 16	19 30	10.00	8.00	1.00	1.50	1 86	
Shenandoah Bone Phosphate	" "	15.28	5.22	3.20	8.42	6.86	2.17	2.42	28 25	23 00	11.00	8.00	1.75	1.75	5 25	
Dissolved S. C. Bone	The Tygert-Allen Fertilizer Co	15.56	11.50	2.57	14.11	1.42			23 47	22 40		14.00			1 07	
Ammoniated Bone and Blood	Greenbrier Meat & Fertilizer Co	11.08	7.97	1.98	9.95	1.13	2.06		24 42	21 62	11.64	10.08	1.20	...	2 80	.
South Carolina Dis. Bone and Phosphate	R. J. Baker	15.52	8.01	6.51	14.51	1.01	..	..	23 82	22 52	15.67	13.12	.	..	1 30	.
Pure Dissolved Raw Bone	"	13.60	10.55	2.68	13.23	.37	2.78	.....	31 95	32 88	13.93	13.68	2.79	.		93
R. J. Baker & Co.'s Bone Meal	"	21.75	.....	.....	.....	....	3.58	.....	35 41	43 32	22.98	21.00	3.30			7 91
Kainit	"						...	12.43	12 43	12 00			...	12.00	43	...
Old Dominion Special Wheat Guano	Old Dominion Guano Co.	8.15	6.09	2.36	8.45	.70	1.83	2.23	23 12	22 40	.....	8.00	2.00	2.00	72	..
Royster's Aigh Grade Acidulated Phos	" " " "	15.78	10.50	3.46	13.96	1.82	....		23 42	20 80	.....	13.00		.....	2 60	...
Eureka Acid Phosphate	Atlantic & Virginia Fertilizing Co.	15.34	11.69	2.11	13.80	1.54	..		23 00	20 80	15.00	13.00			2 20	..

Name of Brand.	Name and Address of Manufacturers or General Agents.	Analysis of Samples Sent by Manufacturers. Total phos. acid pr ct.	Sol. phos. acid pr ct	Rev. phos acid pr ct	Av' phos. acid pr ct	Ins. ph's. acid pr ct	Nitrogen per cent.	Potash, per cent.	V'luat'on per ton.	Guarantee of Manufacturers. V'luat'on per ton.	T't'l phos acid pr ct	Av' phos. acid pr ct	Nitrogen per cent.	Potash, per cent.	Excess of V'luat'on	Defic'y of V'luat'on
Reed, Long & Manning's X X V Bone	Susquehanna Fertilizer Co	10.65	5.97	2.75	8.72	1.93	1.09	1.40	$20 65	$16 91	....	8.00	.82	1.00	$3 64	$...
Dissolved S. C. Phosphate	W. F. & T. P. Lippitt	16.23	11.81	3.31	15.12	1.11	...	.....	24 85	20 18	.....	13.00	....	.....	3 67	....
High Grade Alkaline Bone	Old Dominion Guano Co	12.11	7.39	3.33	10.72	1.39	. .	1.98	19 96	18 00	....	10.00	....	2.00	1 96	....
Ammoniated Bone Phosphate	Susquehanna Fertilizer Co	11.59	6.87	2.93	9.80	1.79	1.18	1.72	24 09	20 61	.....	9.00	1.24	1.50	3 48	....
Dissolved Bone Phosphate	Baltimore Guano Co	16.58	9.30	1.21	13.51	3.07	....	....	23 46	19 80	13.00	12.00	....	.....	3 66	....
Soluble Bone	Lechnder Bros	12.46	.45	7.81	8.26	1.20	.63	....	18 13	19 33	11.11	8 00	.75	.....	.	1 20
Dissolved S. C. Bone	" "	11.12	.67	8.42	9.09	2.33	...	.....	15 91	16 18	11.11	8.00	. .	.....	....	1 54
Bone Meal	Armour & Co	26.01	.....	....	.....	....	2.50	.....	37 71	35 2	25.00	...	2.00	.....	2 49	....
Bone and Blood	" "	11.21	.....	....	....	...	6.44	...	36 91	38 26	14.00	7.00	6.00	.....	...	1 26
Dissolved Bone	" "	12.45	. .	9.30	9.35	3.15	2.19	....	25 09	23 80	12.00	9.00	2.00	.....	1 29	...
Soluble Bone and Potash	Tygert-Allen Fertilizer Co	11.07	6.38	3.62	10.00	1.07	..	3.00	19 64	18 00	. .	10.00	...	2.00	1 64	....

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WEST VIRGINIA

Agricultural Experiment Station

MORGANTOWN, W. VA.

NOTES ON

PRUNING.

HORTICULTURAL DEPARTMENT

Nov. 1892.

CHARLESTON, W. VA.
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1892.

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PRUNING

OF

TREES, SHRUBS AND VINES.

F. WM. RANE, B. AGR., M. S.
Horticulturist.

There has been so much inquiry of the Experiment Station for information regarding pruning, by our farmers and those more particularly interested in the art or science of Horticulture, that the Director has asked me to prepare a bulletin upon the subject.

To treat upon any points which have not already been treated time and again by eminent men, would be practically impossible.

What I here intend and desire to accomplish is to bring before our readers the subject of pruning in such a manner that it will assist any who desire such knowledge, that they may be able after reading this to work more inteligently. It is hoped, also, that many who now, apparently, are negligent as to fruit raising, more particularly may apprehend these fundamental principles and be encouraged to venture in the industry.

Our State to-day is actually importing from other States enough of our more delicate fruits to support numerous horticultural industries of similar nature at home. This should not be and can not continue long. We have almost every advantage, and to allow others to furnish us while we should be producing for ourselves and competing in the great markets of the world, is casting unjust reflection upon our virgin soil, and upon the rightful rank which the name of our State should possess.

We can boast of having one of the largest, if not the largest, fruit farm this side of the Rocky Mountains. The one I refer to in particular is that of the Becker Brothers on the foothills of the Blue Ridge Mountains in Jefferson county. The Becker Brothers purchased a belt of land here in 1887 and immediately set out 33,000 peach trees. Since that time, eight other tracts adjoining have been added, and to-day, the Becker Brothers' fruit farm comprises 2400 acres in one continuous tract.* They have not stopped with peaches alone, but here can be found in great area, vineyards, American and Japanese Plums, Apricots, Japan Persimmons, Quinces, Cherries, Nectarines, English Walnuts, Italian Chestnuts, and Paper-shell Almonds. This magnificent fruit farm is spoken of in this con-

*See description of same in "Weekly Baltimore Sun" Sept 17th, 1892

nection in order to show that in some sections of the State we are progressing rapidly in fruit culture, and as the subject of pruning, if thoroughly familiar, still furthers our success in this pursuit, we can see the important connection.

Pruning has to do with trees, shrubs and vines from the time they are set. If they are neglected, we can not expect them to do their best any more than to expect a trotting horse, thoroughly out of training, to come out and lower his record; or a milch cow, which has been given a certain amount of rations, to give the former quantity or even more milk by depriving her of the original amount of food.

To show further that the interests in horticulture are awakening, the following is taken from the West Virginia Farm Bulletin of June '92. "The following list of gentlemen have recently planted peach orchards in Berkeley County: J. W. Wood, Hedgesville 19,000 trees; J. M. Miller, Gerardstown, 5,000 trees, S. M. McKown, Gerardstown, 5,000 trees; C. W. Richard, Berkely Station, 6,000 trees; Wilson Coe, Gerardstown 2,000 trees, T. L. Richard near Martinsburg, 6,000 trees, J. W. R[illegible]son, Shanghai 3,000 trees; Robert Layman, Martinsburg 1,000 trees; Robert Burkhart, Martinsburg [illegible] trees; Taylor Horner, Hedgesville 500 trees; Mr. Fletcher, Darkesville 500 trees; Mr. Rye, Darkesville 500 trees; Lewis Glover, Darkesville 200 trees; J. T. McKown, Gerardstown 1,000 trees."

When we realize that the above is only an incomplete statement of advance in the peach industry during the past year, in only one county of the State, what can we expect when a [illegible] is compiled for the whole fruit industry of the entire State! It is true that Berkeley county is a model county, however, there are many others just as promising, as for example, Jefferson and Morgan, which bound Berkeley on either side, the numerous inland counties, and the great tier of twelve counties which border the Ohio.

There is not as great a tendency toward the peach industry along the Ohio, but it has been demonstrated already that small fruits and apples, especially, are found to flourish and bear in great profusion. On a whole, we therefore conclude that a bulletin on pruning placed at the farmer's command at this time, may meet the wants of our people.

Pruning Generally Considered.

Webster defines the word "Prune" as from the Fr. *provigner* (to lay in the ground as stocks of vine for propagation.) Now meaning "to cut off the superfluous branches of; to trim; to lop; to retrench; to clip." It is a practice made use of much more in the older countries than in the new. The reason for this, doubtless, is that the population is larger and the demands from the soil are proportionately increased. The soil being all utilized, the interest in these vocations are concentrated on what they already possess, experimenting and studying out how to procure the best possible re-

turns. As a natural consequence, it follows that from the necessity thus arising, they familiarize themselves with the principles necessary to procure the desired end. We find in England, France and Germany, that by pruning and thus becoming more familiar with plant life, the people are able to grow more trees and vines to the acre; produce better fruit both as to size and quality; produce earlier fruit; secure longevity of trees, etc. It is for the above reason, perhaps as much as any other, that so many of our best commercial and practical Florists, Gardeners and Horticulturists are of foreign birth. It is often found that a foreigner coming into a community and once procuring a start, immediately, through his inherent qualities or tendencies is a great teacher to his neighbors, while he may be ignorant on any other subject.

There are still men who advocate that it is wrong to prune trees, basing their reasons in the fact that it is not as nature so intended, and that each interference with nature's laws, in just that degree eradicates and weakens the plant. Thus when a shoot is severed, just that much of the plant's original vitality is lost never to be regained. They cite as instances our native trees, and ask who could have pruned our beautiful forests and procured better results in symmetry and beauty than the hand of nature, as alre dy done. This, it is true, can be made to appear quite possible to a man not thoroughly practical. Were it not for the pruning knife which plays such an important part in our nurseries throughout the country, when scientifically guided, we would be in a barbaric age as regards the industry. It is about as reasonable for a man to sit idly by and say that Nature created plenty of fruits in their natural state, and to improve them by the hand of man is unnatural and therefore, should not be done.

Pruning, although simple, must be practised very cautiously. No operation requires greater foresight than the operation of pruning. We must have a definite object in view, and no branches should be removed for whose removal a good reason can not be given. "The reasons which may justify pruning are:

(1.) The removal of dead or dying branches.

(2.) Thinning.

(3.) Helping the growth of one part of the tree by removing another part."*

It is known that the first named reason is justifiable and anybody, be he skilled or not, can perform the operation; pruning for thinning, or the second named reason, can be done properly without any particular knowledge of plant life; and the third named reason, or cutting out one part in order to assist another part, requires simply good judgment. The manner in which the above classification was more definitely elaborated is about as follows: A few well developed branches are of more value than many which are crowded together without light and air.

*Prof. L. R. Taft's Lecture before the American Pomological Society, 1891. Cultivator and Country Gentleman, Nov. 5th, 1891.

Pruning for the purpose of thinning, accomplishes:—

(a) More freedom of growth for the development of parts.
(b) A production of larger and finer fruit.
(c) Earliness.
(d) Ease in gathering crop.
(e) Less draught upon the soil. *
(f) The crop is more regular.

If possible, the removal of large, healthy limbs should be avoided. The injury is, of course, in proportion to the amount of loss of leaf surface, and the size of wound. Whether to remove a limb or not is a question to be answered in the affirmative only when the benefits expected from the pruning are lager than the necessary injury. Knife and thumb are better pruning tools than ax and saw. Every blow of the ax or push of the saw in the removal of large limbs, is a threat at the tree's life and vitality. By lessening the leaf's surface, we lessen the digestive apparatus, and consequently the absorption of food.

In transplanting nursery grown trees in orchard, we should cut back the tops to make them correspond with the size of the roots. Such trees often have very little root. The best time for pruning trees in orchard, undoubtedly, is in the spring, as at this time plants will take care of themselves. But although we find that this is the best time, it does not seem to be practical, as at the spring time other work is most pressing, and hence pruning is done in fall or winter when time is at hand. Pruning may be done after the formation of dormant buds in summer, as any damage at that time is quickly repaired. When the wounds are large, the injury is lessened by coating them with clay, paint, or grafting wax. Judicious pruning gives us the means of thickening growth or elongating it, and making it more open and spreading.

Root pruning can be resorted to for the purpose of checking rank growth in a tree, vine, or shrub of bearing age; thus hastening its fruitfulness, but it is not usually advisable to resort to such violent means. Low headed fruit trees are usually preferable. Pruning should be seen to from the first by frequent pruning with the knife and thumb.

Pruning of Fruit Trees.

We advise any one who expects to go into the fruit business to

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*"An examination of numerous specimens each, of large and small apples of several different varieties, showed that the weight of seed was not at all propotional to the weight of the fruit. In many, in fact most cases, the total weight of the seeds in the smallest perfectly developed apples was but a trifle short of the weight of the seeds of the specimens of the same variety that weighed two or three times as much. In other words, a given weight of fruit, of the medium-sized, or moderately large apples, contained only one-half as much seed as an equal weight of the same variety composed of twice the number of specimens, did. Chemistry informs us that about 85 per cent. of the mature fruit of an apple is water, and that a very large per cent. of the mineral ingredients is found in the ash of the seed. It is obvious, therefore, that if we wish to make as slight a draft upon the soil, or upon the vitality of our fruit plants, as possible, we should aim, not so much to diminish the total weight, as to diminish the seed, by increasing the size of the individual specimens." From paper by **Prof. W. R. Lazenby, read before the Ohio State Horticultural Society, 1888.**

any extent, to first procure some standard work and get the subject well in hand.* This will add more than anything that can be secured towards success. When the trees are first received from the nursery before setting them out, if they are not already, prune them that the balance between the root and stem is equal, as in Figs 1 or 2. This equalizes the balance, and the tree is in the best possi

Fig 1 (*C. & C. Gen.*)

Fig 2 (*C. & C. Gen.*)

ble condition, other things being equal, o adapt itself to its new environments.

Place the roots in the soil in such a manner that they will radiate qually in all directions. See Figs 2 and 5. That is do not get all the roots

Fig 3. (*C. & C. Gen.*)

*Downing's "Selected Fruits for the Garden and Market," price $2.50, Barry's "Fruit Garden," price $2. Thomas's "American Fruit Culturist," etc. All good books on the general fruits. For each particular kind of fruit can be found special treatises thus devoting the whole attention to the same, as "The Apple Culturist," by S. E. Todd ; "Pear Culture for Profit," bv Quinn, price $1, etc. There are two other books that all Horticulturists should possess, namely, Bailey's "Horticultural Rule Book," price $1. It is a book of the most precise and practical nature, and "The Nursery Book" by the same author, paper bound 50 cts., Cloth $1.00.

on one side of the plant as in Fig 4, as it gives a tendency for the tree to be one sided in after growth, as in Fig 3.

Fig. 4 (*C. & C. Gen.*)

Fig 5 (*C. & C. Gen.*)

In digging up trees for transplanting, caution must be exercised The results obtained are in direct proportion to the amount of care and pains taken in doing the work.

Fig. 6. represents the method pursued in taking up trees in a reckless manner Roots are cut off with the spade at about six inches from the tree leaving from five to six feet of roots in the soil. The top of the tree remaining the same as formerly, they are set out again in the desired location, top-heavy.

Fig. 6 (*C. &C. Gen.*)

Prune with reference to allowing the young trees to procure a solid footing, as in Figs 5 and 7, thus preventing the too frequent example of the tops being too heavy for the roots, and as a consequence, many trees are unable to withstand the switching of the wind

and are obliged to be staked up, or will form a cavity around the base of the stem, as in Fig 8, admitting the drying air to the roots,

Fig. 7 (*C. & C. Gen.*)

checking or arresting growth, and frequently killing the tree. Even if the trees are braced up and held in place by mechanical means. In such cases they can not be expected to remain healthy for

Fig. 8 (*C. & C. Gen.*)

the reason that the root surface is far inferior to that of the branches

and can not supply the tree with enough mineral and sap nutrition. The tree in its natural state is shown well in Fig. 9.

Fig. 9 (*C. & C. Gen.*)

The root system, contrary to the notions of many, spread out and radiate over a considerable space. I might mention, in this connection, the unphilosophical idea prevalent in the minds of many as regards fertilizing trees. The average person wishing to revive his orchard, is found to apply the manure or fertilizer in the immediate vicinity of the trunk. Every one knows that the greatest absorption from the soil takes place through the smaller rootlets, and by examining Fig. 9. we can plainly see that these are in greater numbers some distane from the trunk. Thus to fertilize in order to procure the quickest and most satisfactory returns, the placing of or scattering the fertilizer at some little distance about the tree is advisable.

Prune with reference to the height you desire your branches to start out from the trunk. It is important to remember that a branch which starts from a trunk at a certain height will never get any higher from the ground at its base.

If a person wishes to cultivate his ground for farming purposes, as many do, he thinks it important that the trunk be long in order to raise the branches above the cultivator's head. This may be true, but it is thought more and more that if a person desires to raise fruit and carry on general farming on the same ground he will be likely to fail in both; either devote the ground to one or the other, or one half to one and the remaining half to the other. In this manner of procedure he may thrive in both.

If a trunk separates into two or more equal branches, each branch

grows like a separate tree, but since they generally lean much to one side, they are apt to split apart when loaded with fruit. This may be avoided by keeping the branches subordinate to the main trunk, and the sub-branches subordinate to the main branches.

The tendency of Horticulturists at present is to bring the heads of fruit trees near the ground. The advantages derived from this are :

1. High trees necessitate climbing into them, and they break down. Low ones not so.

2. The low trees can be more easily shaped or pruned.

3. The crop of fruit is easily gathered from low trees.

4. The low headed trees are easily sprayed and thus insects and fungous diseases are more easily combatted.

5. The vigor necessitated by the trunk in a high headed tree is utillized to better advantage by the branches and fruit of the low headed trees.

6. The tendency to draw little plant food from the soil in the way of trunk.

The above is particularly true of drupaceous or stone fruits. The peach, for example, is always sold as yearlings, and when shipped they are cut back to the hard wood. Cut the trees to a stub to make low heads as in Fig 1. Start the head low and train to desired height, which differs with different men. Some train high, others keep the heads low by the shortening in mode of pruning. The latter is practiced by some of our leading peach growers who have the best results. One advantage I notice—in the latter method—is that the trees do not need bracing up when bearing a full crop so much as the former.

While in Michigan last summer, I noticed that the peach trees trained high, in most cases, were in danger of breaking while in fruit, if not propped On the contrary, those pruned on the low heading-in system which were bearing in West Virginia, stood the strain from the weight of the crop perfectly. It is thought by some of our peach growers in the eastern part of the State that by heading-in each year and by producing a strong frame, the tree bears its crop with less danger to the tree, and a more continuous yearly yield is procured.

Like results, doubtless, could be reached with the high headed trees, if growers would not allow their trees to carry too heavy a crop in bearing season. There is some danger of carrying the heading-in system too far. This should be practiced with caution. See letter ,page 24.

Probably the best apple tree to set out is one which is two years from the bud. It may be one to three years old never more than three. The stem of the tree should be straight and should have been trimmed in the nursery about two and one half to three feet up to the first branches. They should have made a good growth from the start, and have a clean smooth bark; as in Fig. 10.

Fig. 10.

The root system should be strong and symmetrical, especially on a sandy land having a hard sub-soil. Fig. 3.

The pruning of young orchards is well expressed in the following:--"After the well shaped trees of a young orchard have been set out, and summer growth has commenced, the owner should keep his eye frequently on the shape the heads are assuming. He can preserve a good symmetrical form with less than a tenth of the labor by rubbing off needless shoots when only an inch or two in growth than by cutting them off with an ax or saw when as large as his arm. Fig. 11. represents a young or nursery tree which had little attention in giving it the best form, the new head constituting a mass of shoots, which have been allowed to grow at random, and which if still neglected, will grow into a bearing tree with straggling and spreading limbs, as shown in Fig. 12. Trees, the pruning of which has not been properly attended to, have not only a bad and straggling appearance, but a portion of them bending downwards interfere with the passage of the gathering wagon, and will be found to have crowded and crossing limbs, and bearing defective and stunted fruit

Fig. 11.

"A skillful hand will bring the heads of such young trees by timely pruning, into a much im-

proved shape, but this pruning should never be undertaken after the trees have commenced growing in the spring. A well shaped young tree, previously well formed is represented in Fig. 10. The work to be done at the present time is to maintain this good shape, and even to improve on it by timely rubbing off, early in the season of growth, all deforming and needless shoots. If this is done at the right time, and every year, very little work will be required. Trees thus properly trained and managed, instead of presenting the appearance shown in Fig. 12, will have the form more nearly resembling Fig. 13.

Fig. 12

"In thinning the shoots which constitute the head of a tree the course must vary with the variety and its peculiar growth. For example, in Rhode Island Greening, the general tendency of the remaining branches should be more upward than in forming the head of a Baldwin, and for the Northern Spy still less than in the more spreading varieties. Less care in this respect is required for the younger trees than after many years when they come into full bearing. Heavily loaded limbs which are borne down continuonsly for several weeks in summer become more or less permanently spreading or drooping and some of them irregular or straggling. The eye of the owner will quickly perceive which shoots can be best spared and rubbed or cut away. If this care is yearly attended to, it will be but trifling when compared to the heavy work required to cut away larger branches after years of neglect.

Fig. 13.

"When trees are quite young, the general tendency of the upward shoots may be controlled in a great degree by leaving the last bud or shoot on the outside of the tree for an erect grower, and on the inside of the tree for one of spreading growth. For example, in pruning a young Spy, let the upper remaining bud or shoot (next to the cut) be on the outside; and for Rhode Island Greening or Roxbury Russet, let the last bud be on the inner side. But it must be remembered that the bearing trees naturally tend to

become more spreading with age by the weight of the successive crops.

"All these matters are subjects of considerable importance. An evenly pruned tree, allowing an even, uniform growth, and fair bearing vigor, will give a crop of finer, handsomer apples than a tree, the head of which more nearly resembles a brush heap, and the bearing shoots of which are crowded, stunted and deformed."*

The best time to order all trees is in the Fall, for then you are apt to get what you want. Later orders will not be filled so accurately and substitutions will be made. This should not be allowed.

If the trees arrive in the Fall, and the ground is in a good condition, they may be set out immediately. Exercise great care in setting at that time; make a mound around them to carry the water off, or else they will heave. Spring is the best time to set trees, and if they are received in the Fall, heal them in. To do this plow a deep furrow and set the trees at an angle of about 30 degrees. Plow the earth over them again and cover with clean straw, or else mice will live there and girdle the trees. Evergreen boughs or leaves are still better.

Pruning of Small Fruits.

Gooseberries, Blackberries, etc.

Pruning of the Currant and Gooseberry are practically the same. About all the pruning that is necessary is to cut out occasionally the old wood and shorten the most vigorous of the young growth If too many shoots or suckers appear and are likely to crowd, a portion of them should be cut out for the advantage of those remaining. A few large and vigorous shoots give more and finer fruit than double that number of weak and immature ones. The Gooseberry requires an open head, more so than the Currant, in order to allow free access of air which checks the mildew.

The Blackberry and the Raspberry are pruned in much the same manner. The method generally practiced is to cut back the canes to the desired length and shorten the lateral ones. This is practically beneficial to Purple Cane and Black Raspberries, as well as Blackberries. It would be better to take out all the old bearing canes soon after the fruit is gathered, but this would make it necessary to go over the plants twice, while if the old canes can be cut out and the young ones pruned at the same time considerable labor is saved. Therefore, one annual pruning is the usual method, choosing the early spring for performing this operation. In field cultivation the Raspberry is given very little pruning except going over the plantation shortly after fruiting and cut close to the ground all the old canes.

*Cultivator and Country Gentleman, June 16th, 1892. Edtorial.

Plate A.

PHOTOGRAPHED BY F WM R,

Sycamore Tree for Shade,
Pruned. See pg. 19,

Plate B

PHOTOGRAPHED BY F. WM. R.

Sycamore Tree for Shade.
Unpruned See pg. 19.

Pruning of Forest Trees.

In the transplanting of forest trees, all should be pruned more or less As with fruit trees, it is almost, if not quite impossible. to take up a tree without destroying a portion of the root , and it is necessary to reduce the number or length of the branches to fully compensate the loss thus sustained. If the tree is to be grown for timber, then a tall straight stem is required, and where there is more than one leading shoot, they should be cut away. Remove the lower branches from time to time, always leaving enough to form a good head to the tree. In cutting off a branch, never cut it off parallel with the tree, but at right angles with the branch severed, as in Fig. 14. All branches indicate the place to sever the same, which is just at the outer edge of the enlargement, found at the base. Endeavor to procure as smooth a cut surface as possible, and if thought necesaary, a coating of melted grafting wax, or any good mineral paint, answers every purpose.

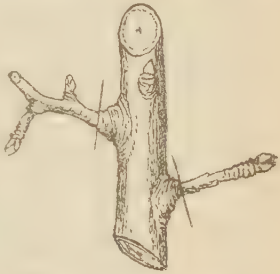

Fig. 14. (*Original.*)

Pruning Ornamental Trees and Shrubs.

This varies as to the idea of the pruner. Many ornamentals can be pruned to take almost any desired form. Especially is this practiced and elaborated by gardeners of the Old World. Trees, through pruning, can be made to produce a dense shade. Plates A and B are perfect examples of this. A was pruned last Spring, while B was not. Both are Sycamore trees growing here in Morgantown of about the same age and size. Both photographs were taken by myself at the same time, and numerous leaves had dropped from both trees. A, besides being more dense, has leaves four or five times their original size.

Pruning Grape Vines.

The reasons for pruning the grape are:—

1. To keep the vine within limits.
2. To have smaller tops than roots.
3. To thin the fruit; even a greater weight of fruit is procured upon trimmed vines

The fruit of the grape is borne upon shoots or wood of the current year which come from wood of the preceding year.

The following should be understood:—

(a) A shoot is a growing branch.
(b) A cane is a matured shoot.
(c) An arm is a cane more than a year old.

The Horrizontal Arm Spur System of Prning.

When the vine is set out, which is generally done in early Spring, it contains about two buds. The stronger is allowed to grow at will all Summer with cultivation, the weaker bud being rubbed off. In the Fall, cut back to two buds again.

Second Season. If the vine is weak repeat the above. If strong allow two shoots to grow and these form the permanent arms of the vine. Plate C is from a photograph taken by myself of the W. Va. Station vineyard at the end of the second year.

Third Season. Cut each arm back to three to four feet, depending on the distance between the plants. Have three wires on a trellis, never more than four are used. Tie the arms to the bottom wire, and allow the shoots to start on each arm about one foot apart. These should be pinched back occasionally during the summer to cause the formation of side branches, which makes the cane stocky. Whenever the shoots reach the top wire, they should be checked from growing further.

Fourth Season. Cut back the shoots to two buds, the stumps being called spurs, and they may have from one to three or four buds. Pinch the shoots as before. This year's growth produces first crop, each shoot bearing from one to three bunches of fruit. From now on cut back the shoot or fruit producing branch to one inch, and new ones will spring forth for following crops.

Arms usually last from four to eight years, and new shoots from the roots are gradually brought up to take their places.

The Renewal System.

By the renewal system of pruning, each arm is allowed to bear but one crop and others are brought up from the roots, leaving three stages present all the time

The Long or High Renewal System.

This system of pruning is the one most practiced. At the end of the second year trim one cane back to two buds, and the other to four buds; the former to grow upright as the previous year, and the latter to be placed at an angle of 45 degrees, and allowed to produce fruit, the fruit spurs being pinched off after three or four leaves have formed beyond the set bud. The next year, the branch producing fruit this year is cut back to two buds, to be grown up-right the next year, while the two parallel shoots are brought to a slant of 45 degrees each way and made the fruit bearing canes of the following year.

The Kniffin System.

This system is much used in the Hudson River Valley. It is supposed to make the vines grow less and bear more. The arms are

Plate C

PHOTOGRAPHED BY F. WM. R.

W Va. Agr. Expt. Station Vineyard, End of Second Year.

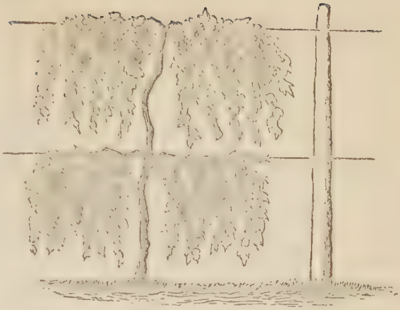

Fig. 15, (*C. & C. Gen.*)

on the top wire, and the shoots hang down as in Fig. 15. They save much tying, hanging down by their own weight and no other care is required except it be to rub off needless shoots, as they start in growth. The chief advantage is in saving of labor; prevention of rampant growth in bearing shoots; fewer wires are used as they are required to support horizontal arms only, but one wire is needed for each arm; and but two wires are required for the trellis.

The best success is procured with the arms kept moderately short. This mode of training is particularly recommended for those who can not spare the time for the more elaborate modes. Fig 16 represents the same system with leaves off.

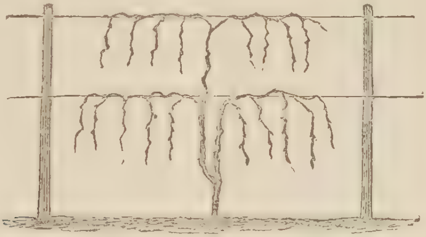

Fig. 16 (*C. & C. Gen.*)

The Modified Horizontal Arm System.

This system is the one practiced mostly in the Chautauqua grape belt. One stem is allowed to grow nearly to the lower wire, and from this, on either side, an arm is carried along the wire These arms are not tied to the wire, but twisted around it two or three times, and thus securely held in place. Each arm is allowed to bear from two to four canes only; the rest are cut away. The plants are set about eight feet apart in the rows, but some growers have the arms only two or three feet long. These arms are not renewed for years.*

The Fan System.

This system is in reality a modification of the Horizontal Arm Spur System. It differs in that the arms are tied and trained on the trellis to represent a fan in shape.

The Thomery System.

This system originated in France. It is neat, symmetric and ef-

*"Grapes in Chautuaqua," American Garden, Nov. 1892, by E. G. Loedman.

fective when thoroughly practiced, but it requires considerable skill and much labor. See Fig. 17.

Fig. 17. (*C. & C. Gen.*)

The Guyot System.

This is a modification of both the Renewal and the Spur systems, but in my estimation not as good as either of the former.

Munson's Alternate Renewal System,

This system is named after T. V. Munson, of Texas, the originator. It consists of two parallel wires each four feet from the ground and two feet apart, which are supported upon the end of slanting posts, which are set in the ground at a point perpendicular to one-half the distance between the wires. Four vines are set eight feet apart between the posts, sending up a branch to each wire, and these in turn extending arms either way upon the wires, which alternate each other in bearing, the fruit hanging down, as in the Kniffin System. This system, to my knowledge, is only practiced in the South.

The Post System

This system of training is declining in favor, the main reason being that it aids mildew of the vines. As the name implies it consists in training to a post, and accompanied with the necessary pruning.

Among my correspondence, I find a letter that I deem of great value, and therefore publish it in full. It is from Mr. Chas. Becker, the Horticulturist, spoken of before;

MILLVILLE, JEFFERSON CO., W.Va.
Nov. 8, 1892.

PROF. F. WM. RANE,
Morgantown, W. Va.

MY DEAR SIR :—Your favor came to hand. I was very glad to hear from you. In regard to our method of pruning the peach, they bear not so many fruits, but larger and better fruits, and as many bushels by shortening them in every season, more or less, according to the growth they make. This season we will not prune them quite so short as we did last season. On account of the drought they did not make as large a growth. We prune the Apricots and Plums

the same as the Peach. We had adopted the "Fuller System" for two years in training our grapes, but found that system no good, as we lose the growth at the crown by that system, so we have adopted the "Fan System" the past season, which we think is the best; although another season will demonstrate it much better, when it will show how the short spurs will act. Grapes can not always be trained just alike, as some are much stronger growers than others; consequently it takes longer to get them in good fan shape.

We commence pruning the latter part of this month, and continue until Spring, taking mild, pleasant days for it. We tie up the vines after we are done pruning.

Yours truly,

CHAS. BECKER,
Horticulturist.

VOLUME III NUMBER 4.

Bulletin No. 28

WEST VIRGINIA

Agricultural Experiment Station

MORGANTOWN, W. VA.

PLAT EXPERIMENTS

WITH

COMMERCIAL FERTILIZERS

ON

CORN.

December 1892.

CHARLESTON, W. VA.
MOSES W. DONNALLY, PUBLIC PRINTER
1893

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EXPERIMENTS WITH CORN.

By D. D. Johnson.

[illegible] as essential to plant growth as these, but generally, nature has supplied them in sufficient quantities to answer all the demands of the plant; therefore one of the problems of great practical [illegible] his soil is [illegible] tion of plants than any of the others, it is very apparent that the [illegible] of production.

[illegible] can raise from seventy-five to one hundred bushels of corn per [illegible] produce the less number of bushels than it does to produce the greater. There are many causes for these failures, such as too [illegible]

[illegible] in one direction only, that of the sufficiency of plant food contained in the soil, and have propounded these questions to the [illegible] benefit of their answers.

For the purpose of making these experiments a plat of ground

twelve rods wide by fifteen rods long was selected in each of the counties of Marshall, Doddridge, Upshur, Roane and Wood. Each of these plats was sub-divided into ten equal parts, each part being twenty-two feet wide, and one hundred and ninety-eight feet long. These sub-plats were separated from each other by a strip thirty-three inches wide, which was neither fertilized nor planted. We endeavored, in all cases, to secure plats of uniform fertility, as far as practicable. The fertilizers were prepared by thorough mixing at the Experiment Station at Morgantown, and shipped to the persons in charge of the out-stations. These persons were also furnished with the following instructions to guide them in all of their operations in making these experiments, and were supplemented by personal visits, or written communications by the Agriculturist.

MORGANTOWN, W. VA., October 27, 1890.

SIR: You will please observe the following

INSTRUCTIONS:

For the government and control of persons in charge of the Experiment Farms of the Agricultural Experiment Station of West Virginia.

A complete record must be kept showing the following facts:

1st. What crop grew on the ground immediately preceding this experiment.

2nd. The date and depth at which the ground was plowed for this experiment.

3rd, The condition of the soil—whether cloddy or well pulverized, wet or dry—at the time of plowing and planting.

4th. The date and manner of planting the seed—whether drilled, sowed broadcast or otherwise.

5th. The date when the seed ' came up."

6th. The appearance of the plants every two weeks from the time of "coming up" to the time of harvesting; stating particularly the effects of drouth, too much rain, and frosts,

7th. A complete daily record of the temperature of the atmosphere at 6 A. M.; 12 M. and 8 P. M., and of the "Rainfall."

8th. The date of snowfall and the length of time it covered the wheat.

9th. The date of ripening, and harvesting; and the weight of the wheat crop (grain and straw) at the time of stacking; and the weight of corn crop (grain and fodder) at the time of husking.

10th. The weight of grain at time of threshing or husking, and number of measured bushels.

11th. The condition of the straw or fodder at the time of cutting.

12th. The condition of the grain at the time of harvesting and at the time of threshing or husking.

13th. Any abnormal condition of the plant or grain, during its

growth; taking care to report any disease or insect attacking the plant, or grain, and preserving samples of the plants so attacked during the different stages of the disease; or ravages of the insect, also preserving specimens of the insect in its several stages of development.

Very Respectfully,
D. D. JOHNSON, Agriculturist.

The soil upon the plat used for experimental purposes at the out-station in the county of Wood, is of the alluvial character common to the Ohio river bottoms, and was cultivated and produced a crop of watermelons during the summer of 1890. For the experiment in corn, it was "broken up" with a two horse plow on the 17th day of April, 1891, to the depth of seven inches. At the time of breaking the ground was wet and cloddy. On the same day it was harrowed over once, and on the 20th day of April, the fertilizers were applied by sowing "broadcast" and thoroughly harrowed in. On the 13th day of May, the ground was furrowed out, and the corn dropped and covered "by hand" three inches deep, the ground being very dry for that season of the year. The rows were 44 inches apart, and the hills 18 inches apart in each row. On the 20th of May, the corn commenced "coming up," about one third of the grain failing to germinate, whether on account of dry weather or inferior seed, is not known. The plants present a healthy appearance.

On the first day of June, the corn was re-planted, plowed and hoed, using a "four-shear" plow turning the soil away from the rows. On the 8th of June the corn was worked over with a cultivator, hoed, and thinned to two stalks to a hill. On the 15th and 22nd of June, and on the 8th day of July, the corn was plowed with a double shovel plow and hoed with the common field hoe. This was the last cultivation the corn received. It ripened and was cut and shocked on the 27th day of October. On the first day of December the corn was husked and the corn in the ear and the fodder were separately weighed. Mr. Stone is of the opinion that there was a loss of about 300 pounds of fodder caused by a wind storm blowing off the blades before the corn was "cut up." No allowance for this loss is made in the calculations in table "A."

The size of the plats are 16 rods, or one-tenth of an acre each, and by multiplying the number of pounds of each kind of fertilizer applied to each plat, by 10, we find the number of pounds per acre. At the Station, we purchase these fertilizers in the original package and mix them ourselves, as may be desired.

The following tables give the amount, kind, and aggregate cost per acre of the fertilizer applied to each plat; the number of pounds of corn and fodder produced on each plat, the number of bushels of corn per acre, and the increased yield, value and profit or loss caused by the use of the fertilizers.

In the calculations of all these tables, 70 lbs. of ear corn is required to make one bushel, all of the corn being in the ear. In the calculations of the cost per acre of the fertilizers applied, their

cost per ton [illegible] of the [illegible] for substitution [illegible] of the [illegible], nitrogen and phosphoric acid contained in the [illegible] will account for the slight difference [illegible] profit and loss as set forth in the tables.

TABLE A.

[illegible] [illegible] [illegible] Application of Commercial Fertilizers in growing Corn, [illegible] [illegible], Wood County, in charge of S. S. Stone, Esq.

VARIETY—GOLDEN BEAUTY.

Number of Plat.	Fertilizers Applied.	Number of lbs. of Ear Corn.	Number of lbs. of Fodder.	Yield per Acre.		Increased Yield per Acre.		Value of Incres'd Yield per Acre.	Cost of Fertilizer per Acre.	Profits per Acre.	Loss per Acre.
		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Dols	Dols	Do	Dol
2	16 lbs. of Kainit & 8 lbs. of Nit. of Soda.	637	550	91	....	27	22½	10.93	2.68	8.25	....
[illegible]	[illegible] Blood.	692	582	98	60	35	12½	14.05	5.00	9.05	....
[illegible]	[illegible] of Potash	590½	508¼	84	25	20	47½	8.27	2.88	5.39	....
5	8 lbs. of Dried Blood, 16 lbs. of Acid Phosphate & 8 lbs. of Mur. of Potash	591¾	487¼	84	37½	20	60	8.34	4.28	4.06	....
6	Nothing	445¾	500	63	47½	...	....	.....	.....	...	...
7	8 lbs. of Dried Fish & 16 lbs. of Kainit...	606½	507½	86	15	22	67½	9.18	1.92	7.26	....
8	8 lbs. of Dried Fish & 16 lbs. Sul. of Potash	544	417	77	50	14	[illegible]	5.61	3.44	2.17	....
9	8 lbs. of Dried Fish & 16 lbs. of Mur. of Potash	507¾	413¾	72	37½	[illegible]	[illegible]	3.54	4.64	..	1.10
10	28 lbs. of Floats, ⅝ lbs. of Mur. of Potash, 1 9-10 lbs. of Sylvite & 2 3-10 lbs of Dried Fish	426	265¾	60	60	-2	56½	-1.12	2.23	...	3.35

TABLE B.

[illegible] the [illegible] [illegible] Application of Fertilizers in growing Corn [illegible] the [illegible] at West [illegible], Doddridge County, in charge of N. E. Duckworth, Esq.

VARIETY—GIANT BEAUTY.

Number of Plat.	Fertilizers Applied.	Number of lbs. of Ear Corn.	Number of lbs. of Fodder.	Yield per acre.		Increased Yield per acre.		Val of increased yield per acre.	Cost of Fertilizer per acre.	Profits per acre.	Loss per acre.
		Lbs.	Lbs.	Bu.	Lbs	Bu.	Lbs	Dols	Dols	Dol	Dol
1	Nothing	[illegible]	[illegible]	51	[illegible]			...	.	....	....
2	16 lbs. of Kainit & 8 lbs. of Nitrate of Soda	395	295	56	30	4	40	1.83	2.68	....	.85
3	16 lbs. of Mur. of Potash & 8 lbs. of Dried Blood	437	295	62	30	10	40	4.23	5.00	....	.77
4	16 lbs. of Acid Phosphate & 8 lbs of Mur. of Potash	455	277	65	....	13	10	5.26	2.88	2.38	....
5	8 lbs. of Dried Blood, 16 lbs. of Acid Phosphate & 8 lbs. of Mur. of Potash...	465	300	66	30	14	40	5.83	4.28	1.55	....
6	3000 lbs. of Stable Manure	507	357	81	....	29	10	11.66	2.25	9.41	....
7	8 lbs. of Dried Fish & 16 lbs. of Kainit...	415	290	59	20	7	30	2.97	1.92	1.05	....
8	8 lbs. of Dried Fish & 16 lbs. of Sul. of Potash	460	290	65	50	13	60	5.54	3.44	2.10	....
9	8 lbs. of Dried Fish & 16 lbs. of Mur. of Potash	480	293	68	40	16	50	6.68	4.64	2.04	....
10	28 lbs. of Floats, 5-8 lbs. of Mur. of Potash, 1 9-10 lbs. of Sylvite and 2 3-10 lbs. of Dried Fish	490	288	70		18	10	7.26	2.23	5.03	....

TABLE C.

Showing the Results of the Application of Fertilizers in growing Corn, at the Out-Station at Wells, Marshall County, in charge of Jeremiah Fish, Esq.

VARIETY—HICKORY KING.

Number of Plat	Fertilizers Applied.	Number of lbs. of Ear Corn.	Number of lbs. of Fodder.	Yield per acre.		Increased Yield per acre.		Val. of Increased Yield per acre.	Cost of Fertilizer per acre.	Profits per acre.	Loss per acre.
		Lbs	Lbs	Bu.	Lbs	Bu.	Lbs	Dols	Dols.	Dols.	Dols.
1	Nothing........................	358	440	51	10	....	....	......	......	......	......
2	16 lbs. of Kanit & 8 lbs. of Nitr. of Soda........................	415	510	59	30	4	65	1.97	2.68	.....	.71
3	16 lbs. of Mur. of Potash & 8 lbs. of Dried Blood........................	380	465	54	20	....	15	—.085	5.00	......	5.085
4	16 lbs. of Acid Phosphate & 8 lbs. of Mur. of Potash........................	424	510	60	40	6	5	2.43	2.88	......	.45
5	8 lbs. of Dried Blood, 16 lbs. of Acid Phosphate & 8 lbs. of Mur. of Potash.	550	630	78	40	24	5	9.63	4.28	5.35	......
6	Nothing........................	405	502	57	60	....	....	......	......	......	......
7	8 lbs. of Dried Fish & 16 lbs. of Kainit.	460	542	65	50	11	15	4.385	1.92	2.565	......
8	8 lbs. of Dried Fish & 16 lbs. of Sulp. of Potash........................	505	602	72	10	17	45	7.06	3.44	3.72	
9	8 lbs. of Dried Fish & 16 lbs. of Mur. of Potash........................	500	590	71	30	16	65	6 77	4.64	2.13	

TABLE D.

Showing the Results of the Application of Fertilizers in growing Corn, at the Out-Station at Spencer, Roane County, in charge of Hon. J. G. Shilling.

VARIETY—GOLDEN BEAUTY.

Number of Plat.	Fertilizers Applied.	Number Pounds of Ear Corn	Number Pounds of Fodder.	Yield per Acre.	
		Lbs.	Lbs.	Bu.	Lbs
1	Nothing........................	No	Corn	Planted.	
2	16 lbs. of Kainit & 8 lbs. of Nitr. of Soda...........	372¾	265	53	10½
3	16 lbs. of Mur. of Potash & 8 lbs. of Dried Blood......	350	388	50	
4	16 lbs. of Acid Phosphate & 8 lbs. of Mur. of Potash...	304	245	43	30
5 6	8 lbs. of Dried Blood, 16 lbs. of Acid Phosphate & 8 lbs. of Mur, of Potash	318	276	45	30
7	Nothing........................	No	Corn	Planted	
8	8 lbs. of Dried Fish & 16 lbs. of Kainit..............	605	410	86	30
9	8 lbs. of Dried Fish & 16 lbs. of Sulp. of Potash.......	133	257	19	
	8 lbs. of Dried Fish & 16 lbs. of Mur. of Potash.......	137	250⅜	19	40
10	28 lbs of Floats, 5-8 lbs. of mur. of Potash, 19-10 lbs. of Sylvite & 2 3-10 lbs. of Dried Fish................	127	249	18	10

TABLE E

Showing the Results of the Application of Fertilizers in growing Corn, at the Out-Station at Buckhannon, Upshur County, in charge of Hon. Thos. J. Farnsworth.

VARIETY—GOLDEN BEAUTY.

Number of Plat.	Fertilizers Applied.	Number of Pounds of Ear Corn.	Number of Pounds of Fodder	Yield per Acre.		Increased Yield per Acre.		Decreased Yield per Acre		Value of Incr's'd Yield per Acre.	Cost of Fertilizer per Acre	Profits per Acre.	Loss per Acre
		Lbs.	Lbs.	Bu.	Lbs	Bu.	Lbs	Bu.	Lbs	Dol	Dol	Dol	Dol
1	16 lbs. of Kainit & 8 lbs. of Nitr. of Sod.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	25			.14	2.68		2.54
2	16 lbs. of Mur. of Potash & 8 lbs. of Dried Blood....................	235.00	280.00	33	40	....	....	2	10	-.86	5.00	....	5.86
3	16 lbs. of Acid Phosphate & 8 lbs. of Mur. of Potash.................	310.00	343.00	44	20	8	40	....	....	3.43	2.88	.55	....
4	8 lbs of Dried Blood, 16 lbs. of Acid Phosphate & 8 lbs. of Mur. of Potash............................	305.00	318.00	43	10	7	60	....	....	3.14	4.28	....	1.14
5	Nothing	250.00	258.00	35	50								
6	8 lbs. of Dried Fish & 16 lbs. of Kainit	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	....	....	[illegible]	[illegible]	....	1.75
7	8 lbs. of Dried Fish & 16 lbs. of Sul. of Potash....................	330.00	320.00	47	10	11	30	....	....	4.57	3.44	1.13	....
8	8 lbs. of Dried Fish & 16 lbs. of Mur. of Potash	262.50	262.50	37	25	1	55			.71	1.64		2.93
9	28 lbs. of Floats, 5-8 lbs. of Mur. of Potash, 1 9-10 lbs. of Sylvite & 2 3-10 lbs. of Dried Fish..........	225.00	225.00	32	10	....	....	3	40	-1.42	2.23	....	3.65

Let us examine table "A," and ascertain, if possible, what answers it gives to our questions. For the sake of convenience, we will multiply the size of the plat, and the amount of each kind of fertilizer put therein, by ten, to enable us to make all of our calculations and comparisons by the acre. We will further ascertain the amount of potash, nitrogen and phosphoric acid contained in each of the fertilizing elements used. We find that plat 6, without any fertilization whatever, produced 445¾ lbs. of ear corn, or at the rate of 63 bushels and 47½ lbs, of corn per acre. By the application of Kainit at the rate of 160 lbs., equal to 22.4 lbs. of potash and 80 lbs. of nitrate of soda, equal to 12 lbs. of nitrogen per acre, we have a yield of 91 bushels, or an increase of 27 bushels and 22½ lbs. per acre at a cost of $2.68 for fertilizers. On plat 7 we apply the same amount of Kainit to supply the potash, but for the nitrogenous fertilizer, we use 80 pounds of dried fish, equal to 6 lbs. of nitrogen and 3.6 lbs. of phosphoric acid, and have a yield at the rate of 86 bushels and 45 lbs. per acre; an increase over plat 6 of 22 bushels, and 67½ lbs per acre at a cost of $1.92 per acre for fertilization.

But let us enquire what effect the substitution of 80 lbs. of dried fish for the 80 lbs. of nitrate of soda produced upon the yield and profits of the crop. We have diminished the nitrogen 6 lbs. which

at 19 cts. per lb., amounts to $1.14, and have added 3.6 lbs. of phosphoric acid, which at 8 cts. per lb. amounts to 28.8 cts., making [illegible] the cost of fertillizers of 85.2 cts. But we have [illegible] of corn of 4 bushels and 25 lbs., worth [illegible] of 88 cts., by the substitution of dried fish [illegible]

[illegible] of the ap- [illegible] the results on [illegible] potash at the rate [illegible] of dried blood, equal [illegible] on plat 9, we have [illegible] same amount of [illegible] 80 lbs. of dried fish, equal to 6 lbs. of nitrogen [illegible] phoric acid producing a yield of [illegible] bushels [illegible] over plat 6 of 8 bushels and 60 lbs., but [illegible] of 26 bushels and 22½ lbs. by the substitution of [illegible] phosphoric acid for 6 lbs. of nitrogen. Query. [illegible]

[illegible] upper bottom of [illegible] or lower bottom [illegible] parallel with the bluff. [illegible] in the natural [illegible] and 10, slightly [illegible] sandy, and [illegible] We, therefore, conclude [illegible] and 10 [illegible] of these plats does not wholly account for the [illegible]

[illegible] we have applied acid phosphate at the rate of 160 lbs., [illegible] per acre. On plat 5 we apply the [illegible] muriate of potash [illegible] equal to 9.6 lbs. [illegible] increase of the [illegible]

[illegible] we find that by the application [illegible] containing 22.4 lbs. of potash, [illegible] containing 12 lbs. of [illegible] and 22 & 1-2 [illegible] of potash, at the [illegible] costing $3.60 [illegible] nitrogen, costing [illegible] per acre. Suppose [illegible] of corn [illegible] hereafter, then [illegible] produced an increase [illegible] of potash applied [illegible] an increased yield [illegible] Therefore, each pound of potash supplied

by kainit produced 58.17 lbs. of corn, and each pound of potash supplied by muriate of potash, produced 24.83 lbs. of corn.

Exclusive of freight and handling, the kainit cost $11 per ton and the Muriate of Potash $45 per ton. Kainit contains 14 per cent., and muriate of potash 50 per cent. of potash. Hence, a pound of potash contained in kainit cost 3.93 cts., and a pound of potash contained in muriate of potash cost 4.5 cts. Therefore, the cost of potash contained in kainit required to produce one bushel of corn is [illegible] cts., and the cost of potash contained in muriate of potash required to produce one bushel of corn is 12.94 cts.

For the purpose of determining the effects of nitrogen and the comparative merits of potash and kainit, let us first compare plats 3 and 7. Plat 3 has a "complete fertilizer," and to supply the necessary plant food, we have used 8 lbs. of muriate of potash, containing 4 lbs. of potash, 16 lbs. of acid phosphate, containing 2.24 lbs. of phosphoric acid, and 8 lbs. of dried blood containing .90 lbs. of nitrogen, or at the rate per acre of 40 lbs. of potash, 22.4 lbs. of phosphoric acid and 9.0 lbs. of nitrogen, producing at the rate of 84 bu. and 37½ lbs. of corn per acre, an increased yield of 20 bu. and 60 lbs.

In plat 7 we also have a "complete fertilizer," in greatly reduced quantities, and to supply the nitrogen and phosphoric acid, we use 8 lbs. of dried fish, containing (.6) six-tenths of a pound of nitrogen, and (.36) thirty-six hundredths of a pound of phosphoric acid, and to supply the necessary potash, we use 16 lbs. of kainit, containing 2.24 lbs of potash, or at the rate per acre of 6 lbs. of nitrogen, 3.6 lbs. of phosphoric acid, and 22.4 lbs. potash, producing at the rate of 86 bu. and 45 lbs. of corn per acre, an increased yield of 22 bu. and 67½ lbs. Here we almost eliminated the phosphoric acid, and reduced the nitrogen 37½ per cent., and the potash 44 per cent., yet we have an increased yield of plat 7 over plat 3 of 2 bu. 7½ lbs.

Now let us inquire whether the substitution of Kainit for the Muriate of Potash caused the increase? In this table (A) we have no data by which we can definitely determine the effects of the application of Phosphoric Acid, but from an inspection of the results produced on Plats 4 & 5, and comparing these results with that produced on Plats 2, 3 & 7, we may safely infer that the applications of Phosphoric Acid to the soil contained in these plats produced no material effect. By a further comparison of Plats 2 & 7, we find that Plat 2 has 6 lbs. per acre more Nitrogen than Plat 7 and that it produced 5 bu. and 25 lbs. more of corn than Plat 7. Supposing that the Nitrogen applied produced this increased yield, we then find that one pound of Nitrogen produced an increased yield of 50 and 5-6 lbs. of corn. We have already seen that there were 12 lbs. per acre applied to Plat 2, and 6 lbs. to Plat 7. Deducting from the increased yield of each of these Plats, the amounts produced by the application of Nitrogen, we find the increased yield produced by the application of 22.4 lbs. of Potash in the form of Kainit on Plat 2 to be 18 bu. and 42

1-2 lbs., and on Plat 7, 18 bu. and 42 1-2 lbs.; exactly the same. Now, let us ignore the Phosphoric Acid applied to Plat 5, and deduct the increased yield produced by 9.6 lbs. of Nitrogen (amounting to 6 bu. and 68 lbs.) from the gross increased yield, then we have remaining 13 bu. and 62 lbs. as the increased yield produced by the application of 40 lbs. of Potash in the form of Muriate of Potash; an increased yield of 24.3 lbs. of corn for each pound of potash applied; agreeing almost exactly with Plat 3, in the quantity of potash contained in Muriate of Potash required to produce one bushel of corn. Hence, it is clear that the Kainit not only produced the increased yield of 2 bu. and 7 1-2 lbs. but also made up the deficit caused by the diminution of the Nitrogen applied to Plat 5, the actual increase being 4 bu. and 50 1/2 lbs. We find, therefore, that the application of 80 lbs. of Muriate of Potash, costing $1.80 produced an increased yield of 13 bu. and 62 lbs. and the application of 160 lbs. of Kainit costing 88 cents, produced an increased yield of 18 bu. and 42 lbs.

The land upon which the experiment was conducted in the county of Doddridge is commonly described as "hill land," having a northern and western exposure. The soil is a "clay loam" and had been in grass, and used as a pasture field for several years previous to the experiment. The ground was plowed on the 18th and 19th, and the fertilizer applied by sowing broad cast, and harrowed in on the 30th day of March, 1891. The corn was planted on the 30th day of April. Because of dry weather, the corn did not come up until about the 15th day of May, and did not make a very good "stand," but it was at once replanted, and the "replant" came up in a few days thereafter. The corn was cultivated on the 30th day of May, 14th day of June and 25th day of June.

To what extent does the result of the application of Kainit and Muriate of Potash to the soils on the experiment grounds at West Union, correspond with the results obtained by their application to the soil on the experiment plats at Seldon? By an examination of the formulas for plats 4 and 5, table B, we find that the same amount of Phosphoric Acid and Potash was applied to each of these plats, and that to plat 5 was applied 8 lbs. of Dried Blood. The increased yield of plat 5 over plat 4, which we may presume was caused by the use of Dried Blood, was 1.10 lbs. or nearly 11.46 lbs. of corn for each pound of nitrogen applied. Subtracting the increased yield produced by nitrogen (2 bu. and 66 1/4 lbs.) on plats 2 and 7 from the total increased yield of these two plats, we have 9 bu. and 3[illegible] 3-4 lbs. as the increased yield caused by the application of Kainit, or 14.15 lbs. of corn for each pound of Potash used. Eliminating in the same manner the increased yield produced by nitrogen on plats 3 and 9, we have an increased yield of 24 bu. and 51 1/4 lbs. as the increased yield of these two plats, caused by the application of Muriate of Potash, or 10.82 lbs. of corn for each pound of Potash used. The increased yield for

each pound of potash applied, was a little more than 37.7 per cent. more for the Kainit than for the Muriate of Potash.

The land used in the experiment in Marshall county is a steep hill side with a north-western exposure, and the soil is a dark clay loam. A crop of grass had been grown on this land the previous year. The ground was broken up in April, the fertilizer sown broadcast and "harrowed in" and the plats planted on the 13th day of May, and given the usual cultivation during the growing season.

Pursuing the same methods in our calculations that were adopted in tables A. and B., we find that in table C., the increased yield caused by the application of potash to plats 2 and 7 is 14 bu. and 50 lbs and the increased yield caused by the application of potash to plats 3 and 9 is 15 bu., or for the kainit, an increased yield of nearly 21.03 pounds of corn for each pound of potash applied, and for the muriate of potash, an increased yield of nearly 6.25 lbs. of corn for each pound of potash applied.

Tables D. and E. confirm the claims of kainit as a potash fertilizer for corn, and seem to give it the decided preference, but as we have no data of the increased yield in table D., and as the yield of plats 7 and 9, of this table and plats 2 and 7 of table E are all abnormal and inexplicable, we shall not attempt to analyse or compare their results with the results obtained in the experiments set forth in tables A, B, and C.

Let us inquire what are the comparative merits of muriate of potash and sulphate of potash as a fertilizer for corn as shown in these tables? Remembering that muriate of potash, containing 50 per cent of potash, costs $45 per ton, and that sulphate of potash, containing 25 per cent of potash, costs $30 per ton, or to state it more plainly, the potash contained in muriate of potash costs 4.5 cts. per pound, and the potash contained in sulphate of potash costs 6 cts. per pound; by a comparison of plat 8, with plat 9 of all these tables, we may be able to answer this inquiry.

Tables A, D, and E seem to show a very decided preference for sulphate over muriate of potash, but the greatly diminished natural fertility of the soil in plat 9 from that of plat 8 in table A, and the same conditions existing in the fertility of the soil in plats 8 and 9, table D, and the abnormal yield of plat 8 in table E, would not justify us in comparing the yield of these plats with the other and deducing therefrom a conclusion as to the relative merits of the fertilizers used. But in tables B and C we encounter no such difficulty, as no appreciable difference could be seen in the natural fertility of the soil in plats 8 and 9 at each of the out stations represented by these tables. Supposing that dried fish produced the same effect on each of these plats at each of these stations, and deducting the amount thus produced (as heretofore determined) from the increased yield of these plats, we find that we have an increased yield in table B of 22.29 lbs. for each pound of potash contained in Sulphate of Potash, and an increased yield of 13.77 pounds for each pound of potash contained in Muriate of Potash, and in table C. an increased yield of 29.19 pounds of corn for each pound

of potash contained in Sulphate of Potash, and an increased yield of 13.95 pounds of corn for each pound of potash contained in Muriate of Potash.

In the use of Floats as a fertilizer, the results obtained in these experiments are very unsatisfactory. The decreased production of plats 10 in tables A, B and C we are convinced, was caused by the decrease in the natural fertility of the soil in these plats. In plat 10, table B, where the natural fertility of the soil was maintained, we have a very gratifying increase in the yield. On plat 6, table B, we applied 3,000 pounds of stable manure, producing an increased yield at the rate of 29 bu. and 10 lbs. per acre, giving us a net profit of $9.41. As stable manure is a thing which must be produced whether it be utilized or not, we have fixed its price at what it costs to spread it upon the field. It will be seen that this plat yielded a larger profit than any other plat in the whole series of experiments. Although great care was exercised in the selection, we have found it almost impossible to secure ten consecutive plats possessing the same characteristics, and having a uniform natural fertility. Under such circumstances, of course, there are elements of uncertainty entering into all these experiments. In our efforts to state the facts brought out by the results as stated in these tables, we have endeavored, as far as possible, to eliminate all uncertain factors, and give the conclusions which these experiments seem to warrant.

The results of the application of potash as a fertilizer, in these experiments, as set forth in the several tables, may be summarized as follows:—

Table A. 1 lb. of Potash contained in Kainit produced 58.17 lbs. corn.

Table A. 1 lb. of Potash contained in Mur. of Potash produced 24.68 lbs Corn.

Table A. The cost of Kainit to produce 1 bu. of Corn is 4.73 cts.

Table A. The cost of Mur. of Potash to produce 1 bu. of corn is 12.94 cts.

Table B. 1 lb. of Potash contained in Kainit produced 14.79 lbs. Corn.

Table B. 1 lb. of Potash contained in Mur. of Potash produced 10.82 lbs. of Corn.

Table B. 1 lb. of potash contained in Sulph. of Potash produced 22.29 lbs. Corn.

Table B. The cost of Kainit to produce 1 bu. of Corn is 18.61 cts.

Table B. The cost of Mur. of Potash to produce 1 bu. of Corn is 29.25 cts.

Table B. The cost of Sulph. of Potash to produce 1 bu. of Corn is 18.57 cts.

Table C. 1 lb. of Potash contained in Kainit produced 21.03 lbs. Corn.

Table C. 1 lb. of Potash contained in Mur. of Potash produced 6.25 lbs Corn.

[illegible] produced 29.19 lbs. Corn.

[illegible]

Table C. The cost of Muriate of Potash to produce 1 bu. of Corn is 49.68 cts.

Table C. [illegible] Corn is 14.38 cts.

The average [illegible]

[illegible]

[illegible] contained in Muriate of Po:ash is 15.91 lbs.

[illegible] is 9.06 cts.

The average cost of Sulphate of Potash required to produce 1 bu. of corn is 16.32 cts.

[illegible] of corn is 19.35 cts.

TABLE F.

[illegible] Rudolf de Roode, Ph. D., Chemist.

Laboratory Number	Owner of Farm From Which Samples of Soil Were Taken.	Percentage fertilizing elements.			
		Nitrogen.	Phos. Acid.	[illegible]	[illegible]
12	S. S. Stone, Esq., Seldon, Wood Co., W. Va.	.132	.153	[illegible]	[illegible]
13	A. P. Sinnet, Esq., Charleston, Kanawha Co., W. Va.	.138	.121	[illegible]	[illegible]
14	Jeremiah Fish, Esq., Wells, Marshall Co., W. Va.	.131	.167	[illegible]	[illegible]
15	N. E. Duckworth, Esq., West Union, Doddridge Co.	.184	.105	[illegible]	[illegible]
16	Thomas J. Farnsworth, Esq., Buckhannon, Upshur Co., W. Va.	.215	.103	[illegible]	[illegible]
17	Col. John A. Robinson, Patterson's Depot, Mineral Co., W. Va.	.131	.088	[illegible]	[illegible]
46	S. S. Stone, Esq., Selden, Wood Co., W. Va.	.091	.115	[illegible]	[illegible]
47	Jeremiah Fish, Esq., Wells, Marshall Co., W. Va.	.181	.185	[illegible]	[illegible]
48	S. S. Stone, Esq., Selden, Wood Co., W. Va.	.112	.181	[illegible]	[illegible]
49	Hon. Thomas J. Farnsworth, Buckhannon, Upshur Co.	.171	.095	[illegible]	[illegible]
50	N. E. Duckworth, Esq., West Union, Doddridge Co.	.177	.121	[illegible]	[illegible]
51	J. G. Schilling, Esq., Spencer, Roane Co., W. Va.	.091	.093	[illegible]	[illegible]
52	Edward Kyle, Esq., Cox's Landing, Cabell Co.	[illegible]	[illegible]	[illegible]	[illegible]

Samples of [illegible] tions selected for experiments in wheat in 1890, and also from the stations selected for experiments in corn in 1891, and delivered to the Chemist for analysis. Table F. gives the results of these analyses. Numbers 12, 13, 14, 15, 16, 17 and 53 are the samples taken from the wheat plats, and numbers 47, 48, 49, 50 and 51 are the samples [illegible] another part of the farm of Mr. Stone.

Prof. Lupton states the amount of Potash usually found in a fertile soil to be 0.200 per cent. The "American Farm Book" by R. L. Allen, and revised and enlarged by Lewis F. Allen, gives an analysis of four soils of "arable lands of great fertility" which states the percentage of Potash contained in them to be 0.140, 0.120; 0.240 and 0.100 respectively. It will be seen that in none of the cases given does the potash exceed twenty-four hundreths of one per cent. while in the analysis of our soils as shown in this table, the percentages of Potash in every case exceeds that amount, the lowest being 0 243, and the highest 0.688, showing that they contain a great deal more Potash than is essential to a fertile soil. The table given by Prof Lupton requires 0,450 or a little less than one-half of one per cent of phosphoric acid, and nearly six per cent of lime, and the "American Farm Book" requires about one per cent of nitrogen and gives several instances of very fertile soils containing from 22 to 37 5 per cent of lime. If these be the correct standards, then our soils as shown by these analyses contain an abundance of potash, and fall very far below the required amount of phosphoric acid, nitrogen and lime. Almost all over West Vriginia there is an abundance of limestone and coal, thus giving the farmers at a very small cost, the means of increasing the productiveness of their soils to a wonderful extent.

These analyses undoubtedly show the percentage of nitrogen, phosphoric acid, potash and lime contained in these soils, but they certainly fail to show the percentage of these fertilizers which are available as plant food Let us examine No. 48 which shows the analysis of samples of soil taken from the land of Mr. Stone, upon which the experiment shown in Table A, was made. Suppose that 18 cubic feet of this soil weighs 2000 lbs., then the soil covering one acre to the depth of six inches, weighs 2,420,000 lbs., containing, according to this analysis, [illegible] lbs. of nitrogen, 4452 lbs. of phosphoric acid and [illegible] lbs of potash. The largest yield per acre (plat 3.) is 6920 lbs of corn, containing 97.50 lbs. of Nitrogen, 39.51 lbs. of Phosphoric Acid, and 32.66 lbs. of Potash, and 5,820 lbs. of fodder containing 102,51 lbs. of Nitrogen, 31 54 lbs. of Phosphoric Acid, and 51.73 lbs. of Potash, the corn and fodder together containing 200.01 lbs. of Nitrogen, 71.05 lbs. of Phosphoric Acid and 84.39 lbs. of Potash.

The yield per acre without artificial fertilization (Plat 6) is 4.457.5 lbs. of corn containing 62.80 lbs of Nitrogen, 25 45 lbs. of Phosphoric Acid and 21.04 lbs. of Potash and 5.000 lbs. of fodder, containing 88.15 lbs. of Nitrogen, 26.10 pounds of Phosphoric Acid and 44.45 lbs. of Potash; the corn and fodder together containing 150.95 lbs. of Nitrogen, 51 55 lbs. of Phosphoric Acid and 65.48 lbs of Potash. Here we have contained naturally in this soil Nitrogen enough to produce eighteen, Phosphoric Acid enough to produce eighty six and Potash enough to produce one hundred and sixty nine such crops, proving conclusively that a very large quantity of these elements of plant food are not available in their present condition. The ratio of availability seems to be inversely as to

[illegible] all three of these elements of plant food (Plat 5, Table A.) we have [illegible] pounds of fodder.

By the omission of the phosphoric acid, and doubling the [illegible] Nitrogen, and have recovered in the increased yield [illegible]8.90 lbs. [illegible] Here we recover 23.62 per cent. of the Potash and receive back more than five times the amount of Nitrogen applied, and 18.50 lbs. of Phosphoric Acid. In Plat 3, we applied at the rate of 22.4 lbs. of Potash and 12 lbs. of Nitrogen per acre, and have an increased yield of 27 bu. and 23 1-2 lbs. of corn and 500 lbs. of fodder, returning to us in the increased yield 13.47 pounds of Potash, 36.78 lbs. of Nitrogen and 13.60 lbs. of Phosphoric acid. Here we recover in the increased yield a little more than 60 per cent. of the Potash, and three times the amount of Nitrogen applied; and in addition thereto, we have 13.60 lbs. of Phosphoric acid.

[illegible] we shall not attempt to answer:

What effect does the potash applied have upon the Potash, Nitrogen and Phosphoric Acid or either of them, already contained [illegible] soil, available as plant food and does the plant refuse to appropriate [illegible] soil?

My attention has been called to the analysis of some very fertile and productive soils containing a much smaller percentage of Potash, Nitrogen and Phosphoric Acid, but a much larger quantity of lime than any of the soils mentioned in these tables.

In conclusion, we desire to call the attention of West Virginia farmers to the following extract from Prof. Lupton's "Elementary Principles of Scientific Agriculture:" "The applications of lime to soils furnishes at least one mineral constitutent to plants, one, however, [illegible] tains so much as to the other important purposes which it serves. Its alkaline properties cause it to neutralize acids, which sometimes [illegible] and aids in the decomposition of organic substances, and of some insoluble inorganic compounds. In other words, lime corrects "sourness" in lands, destroys excess of vegetable matter, lightens heavy [illegible] silicates."

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Bulletin No. 29

WEST VIRGINIA

Agricultural Experiment Station

MORGANTOWN, W. VA.

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1. Experiments on Potatoes, at the Station.

2. Experiments on Corn at the Out Stations

AGRICULTURAL DEPARTMENT.

January 1893.

CHARLESTON, W. VA
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POTATO CULTURE AND FERTILIZATION.

By D. D. Johnson, *Agriculturist.*

In 1891 we conducted an experiment at the Station for the purpose of determining the effects of Kainit used alone, and combined with phosphoric acid and nitrogen, as a fertilizer in growing potatoes, and in connection therewith, to test the production of some leading varieties, and the comparative effects which would be produced by planting the whole potato, the halves, the quarters, and cut in pieces each having one eye. The results of that experiment were published in Bulletin No. 20, of January, 1892. The following is a repetition of the experiment made in 1891, each plat occupying the same ground that it did then, except that the rows were placed a little closer together to avoid the "old stony fence row," which, to a slight extent, interfered with the accuracy of the former experiment.

It is stated in Bulletin No. 20 that the land upon which the experiment was made "is a yellowish gray soil, and has probably been cultivated for more than fifty years, being so completely 'worn out' that there was no profit but an actual loss in its cultivation." The crop this year was almost a complete failure, caused by the unfavorable season, and the exhausted condition of the soil. The latter of these causes will be more particularly referred to when we come to speak of the productions of Plat 11.

The first twelve rows of each plat were planted with Early Rose; the second twelve with White Star, and the third twelve with Beauty of Hebron. The first three rows of each variety were planted with whole potatoes, one in each hill, the hills three feet apart, making six hills in each row on each plat. The second three rows of each variety were planted with halves cut lengthwise, one piece in each hill, the hills eighteen inches apart. The third three rows were planted with quarters cut lengthwise, one piece in each hill, the hills nine inches apart; and the fourth three rows of each variety were planted with pieces containing one eye each, three pieces in each hill, the hills nine inches apart, the object being to secure the same amount of "seed" in each row.

The Early Rose and White Star were planted on the 8th, and the Beauty of Hebron on the 12th of April. The potatoes were fertilized when the more vigorous plants were three inches high. The plants produced by the whole potato came up with the usual

vigor and thrift, but those from the halves quarters and single eyes were diminutive, "spindling" and weakly, showing a very marked contrast between them and the plants from the whole potatoes. It is a well known fact that the young plant at first draws its entire nourishment from the seed which produces it. The source of supply is only temporary; therefore, the plant puts forth roots to draw its nourishment from the soil as the original source of supply becomes exhausted. While in this transition state, unless the soil be well supplied with available plant food, the plant becomes weak, "spindling," starved, and fails to make the necessary growth. In the experiment in 189', there was only a very slight difference in the growth of the plants produced by the whole potato, from those produced by the halves, quarters and single eyes. We must, therefore, conclude that the difference in the early growth of the plants in the experiment of 1892 was caused by the almost complete exhaustion of the natural available plant food in this soil by the crop of 1891. The plant food contained in the seed furnished the plants produced by the whole potato, a sufficient amount of nourishment to enable the plant to change its source of supply from the "seed" potatoes to the soil with less serious results, while the others were compelled to make this change and adapt themselves to the new condition with one-half and one fourth this support. The growth of all these plants, after the nourishment contained in the "seed" potato had become exhausted and the change to plant the food contained in the soil had been accomplished, was comparatively the same. About the first of June, the plants produced by the whole potato were about three times as large as the others, while on the 15th of July, they were about one-fifth or twenty per cent. larger. It seems from this experiment, when compared with that of 1891, that it is much more disastrous to the productive powers of the plant to deprive it of the necessary plant-food while it is young, than to do so when it is making its fruit, especially is this the case in the Early Rose variety.

Following the lines of investigation laid down in Bulletin No. 20, the results of this experiment will be treated as follows:

1st. The comparative yield of large and small tubers of the several varieties produced by the use of different fertilizers.

2nd. The increased yield produced by different fertilizers; their cost, and profit and loss.

3rd. The comparative yield of tubers, planted whole, in halves, quarters, and cut to single eyes.

TABLE A

Showing the Results of the use of Commercial Fertilizers in growing Potatoes.

Number of Plat.	Fertilizers used. Kainit	Nitrate of Soda.	Acid Phosphate (Dis. Bone)	Early Rose. Large	Early Rose. Small	Early Rose. Total	White Star. Large	White Star. Small	White Star. Total	Beauty of Hebron. Large	Beauty of Hebron. Small	Beauty of Hebron. Total	Total. Large	Total. Small	Total. Total
				Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
1	42	...		38.6	10.1	48.7	45.9	12.2	58.1	21.0	12.6	33.6	105.4	34.9	140.4
2	42	8 33		26.7	11.0	37.7	40.8	12.6	53.4	19.4	6.8	25.2	86.7	30.4	117.1
3	42		21	24.3	11.2	45.5	59.8	12.2	72.0	32.3	10.6	42.9	126.4	34.0	160.4
4	42	8 33	21	19.5	7.5	27.0	45.8	13.0	58.8	24.1	8.5	32.6	89.4	29.0	118.4
5	Nothing.		..	16.5	11.0	27.5	23.9	15.1	39.0	12.6	9.4	22.0	53.0	35.5	88.5
6	31½	.		18.2	7.4	25.6	24.7	11.2	35.9	14.9	9.9	24.8	57.8	28.5	86.3
7	31½	8 33		20.3	9.7	30.0	18.6	12.0	30.6	9.8	6.9	16.7	48.7	28.6	77.3
8	31½	...	21	26.3	17.7	44.0	39.4	12.2	51.6	29.4	11.0	40.4	95.1	40.9	136.0
9	31½	8 33	21	25.3	15.0	40.3	43.0	13.1	56.1	30.4	12.6	43.0	98.7	40.7	139.4
10	21	.....	.	12.2	11.9	24.1	12.9	9.5	22.4	17.1	12.0	29.1	42.2	33.4	75.6
11	Nothing.			22.6	12.7	35.3	24.6	13.8	38.4	25.1	16.0	41.1	72.3	42.5	114.8

1. The comparative yield of large and small tubers of the several varieties, etc.

Table A sets forth in detail the amount and kind of fertilizers used on each plat, and the yield of large and small tubers of each variety. The very largely increased percentage of small potatoes in the crop of 1892 over that of 1891 was caused, no doubt, by the exhausted condition of the soil and the unfavorable season. The plants made the effort to produce a crop, but failed because of the lack of sufficient nourishment to develop the tubers to their normal size. Taking the first four plats, a combination of Kainit and S. C. Dissolved Bone produced the greatest amount of large and the smallest percentage of small tubers. Kainit alone stands next. A combination of Kainit, S. C. Dissolved Bone and Nitrate of Soda takes third place, while a combination of Kainit and Nitrate of Soda produces the smallest amount of large and the greatest percentage of small tubers. In the second four plats, from six to nine inclusive, where the amount of Kainit is reduced one-fourth, a combination of all three fertilizers produces the greatest amount of large and the smallest percentage of small tubers. A combination of Kainit and S. C. Dissolved Bone (Potash and Phosphoric Acid) stands next, and Kainit takes the third place, while Kainit and Nitrate of Soda again produces the smallest amount of large and the greatest percentage of small tubers. In the experiment of 1891, the same conditions exist throughout with the single exceptions that in the first four plats, the Kainit plat and the Kainit and Nitrate of Soda plat exchange places. We are utterly unable to account for the comparatively large yield of Plat 1, in the crop of 1892, but this yield accounts for the difference in the results of the experiments for the two years, as just stated.

From this part of the experiment, we draw the same inference we did last year, viz: "The more efficient the fertilizer, the less will be the ratio of small to large tubers."

TABLE 3.

S[illegible] Results [illegible] Fertilizers in Production, P[illegible] L[illegible] Potatoes.

[illegible]				Early Rose.						White Star.					
[illegible]	[illegible]	[illegible]	South Carolina Dissolved Bone.	Yield.	Increased Yield.	Value of Increased Yield.	Cost of Fertilizer.	Profit.	Loss.	Yield.	Increased Yield.	Value of Increased Yield.	Cost of Fertilizers.	Profit.	Loss.
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Cts.	Cts.	Cts.	Lbs.	[illegible]	Cts.	Cts.	[illegible]	Cts.
1	[illegible]			[illegible]	[illegible]	[illegible]	7.66	10.50	.....	58.1	[illegible]	17.37	7.67	9.70	.
2	[illegible]	[illegible]	.....	37.5	10.0	8.33	13.91	....	5.58	53.4	[illegible]	13.25	13.91	..	0.66
3	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	12.42	2.35	.....	72.0	[illegible]	28.95	12.42	16.53	...
4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	19.8	[illegible]	18.67	.	1.05
5	Nothing			[illegible]						[illegible]					..
6	[illegible]			[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		6.41
7	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		17.46
8	[illegible]		21	44.0	16.5	10.39	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
9	[illegible]	[illegible]	21	40.3	12.8	8.66	[illegible]		8.11	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
10	[illegible]			24.1	—3.4	—3.28	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	3.83		14.69
11	Nothing			35.3	7.8	5.64	.....	5.64	.....	38.4	[illegible]	[illegible]	..		[illegible]

TABLE B.—Continued.

Showing the Results of the use of Commercial Fertilizers in Production, Profit and Loss, in Growing Potatoes

Number of Plat.	Fertilizers Used.			Beauty of Hebron.						Totals.						Yield per Acre.	Increased Yield per Acre.	Profit per Acre.	Loss per Acre.
	Lainit.	Nitrate of Soda.	South Carolina Dissolved Bone	Yield.	Incresed Yield.	Value of Increased Yield.	Cost of Fertilizers.	Profits.	Loss.	Yield.	Increased Yield.	Value of Increased Yield.	Cost of Fertilizer.	Profits.	Loss.				
	Lbs	Lbs	Lbs	Lbs	Lbs	Cts	Cts	Cts	Cts	Lbs	Lbs	Cts	Cts	Cts	Cts.	Bus.	Bus.	Dols	Dols.
1.	12			33.6	11.6	8.16	7.67	0.49		140.4	51.9	45.63	23.06	20.69		48.6	17.3	1.13	
2.	42	8.33	....	25.2	3.2	4.80	13.91	....	9.11	116.1	27.6	26.38	41.73	....	15.35	38.7	9.2	....	3.07
3.	42	....	21	42.9	20.9	16.81	12.42	4.39	....	160.4	71.9	60.53	37.26	23.27	....	53.4	23.9	4.65	....
4.	42	8.33	21	32.6	10.6	9.28	18.66	....	9.38	117.4	28.9	28.23	56.00	....	27.77	39.1	9.6	....	5.55
5.	Nothing.		...	22.0	....	....	....	....	....	88.5	....	....	....	....	....	29.5	....	....	....
6.	31½	....	...	24.8	2.8	2.42	5.77	....	3.65	86.3	—2.2	1.27	17.31	....	16.04	28.7	—0.8	....	3.20
7.	31½	8.33		16.7	5.3	3.16	12.02		15.18	77.3	11.2	5.87	36.06		41.93	25.7	3.8		8.38
8.	31½	....	21	40.4	18.4	14.53	10.52	4.01	....	136.0	47.5	36.87	31.56	5.31	....	45.3	15.8	1.06	....
9.	31½	8.33	21	43.0	21.0	15.89	16.77	....	0.88	139.4	50.9	39.80	50.31	....	10.51	46.4	16.9	....	2.10
10.	21	....	....	29.1	7.1	4.61	3.83	0.78	....	75.6	—12.9	—9.53	11.49	....	21.02	25.2	—4.3	....	4.20
11.	Nothing		..	41.1	19.1	12.61		12.61		114.8	26.3	18.10	......	18.10		38.2	8.7	3.62	

11. The increased yield produced by the use of commercial fertilizers, and the profit and loss in the use of the same.

Table B shows the amount and cost of the fertilizers used, the yield and the increased yield produced by the use of fertilizers; the value of the increased or decreased (–) yield (estimating the value of the large tubers at fifty cents and the small one at twenty cents per bushel) and the profit and loss of fertilization of each variety on each plat, and the increased yield, profit and loss per acre.

Here again, we have a remarkable agreement with the facts brought out in the experiment of 1891. Plat No. 5, without any fertilization produced 88½ pounds, while Plat 1, with 42 pounds of Kainit produced 140.4 pounds. In Plat 2, to the Kainit, we added 8⅓ pounds of Nitrate of Soda and decrease the yield 24.3 pounds, but have an increase over the unfertilized plat of 27.6 pounds. In Plat 3, by adding to the Kainit 21 pounds of S. C. Dissolved Bone, we increase the yield to 160.4 pounds, an increased yield of 20 pounds over plat 1, and an increase of 71.9 pounds, or 81.24 per cent. over the unfertilized plat. We add 8⅓ pounds Nitrate of Soda to the amount of fertilizer applied to Plat 3, thus making a "complete fertilizer" and apply it to Plat 4, resulting in a yield of 117.4 pounds, an increased yield over the unfertilized plat of 28.9 pounds, but a decreased yield from Plat 3 of 43 pounds.

Taking plats 6, 7, 8, and 9 we find a slight variation from the results of 1891. Plats 6 and 7 falling below the yield of the unfertillized plat. In Bulletin No. 20, page 132, it is stated "That part of No. 6 on which the Early Rose were planted, and the whole of No 7 was very poor. Here is strong evidence of the exhaustion of the small amount of plant food naturally existing in this soil by the crop of 1891, Our estimate of the natural fertility or rather natural sterility of this soil in the former experiment is fully sustained by the experiment of 1892. Taking plats 8 and and 9, on which the natural fertility was nearly the same as on Plats 1, 2, 3 and 4 we find the effects of the fertillizers to be very nearly what they were in 1891, the yields in plats 8 and 9 are much below the yields in plats 3 and 4 for both years, which it is believed are fully accounted for by the reduction of one-fourth in the amount of potash fertilizers applied to these plats. It will be observed that in both years, plat 3 produced a larger yield than plat 4, while plat 9, corresponding with plat 4, produced a larger yield than plat 8 which corresponds with plat 3. It was stated in the former bulletin that plat 9, probably contained the most fertile spot in the entire series of plats. This statement seems to be fully sustained by the last experiment and explains the abnormal increased yield of that plat.

To the ten plats of 1891 was added Plat 11 in 1892. Plat 11 adjoins Plat 10, and when the soil was "broken up" in March, 1891, there was no perceptible difference in the natural fertility of the soils of these two plats. They were both yellowish gray clay soil containing but very little humus. Both plats were broken up at the same time, and while Plat 10 was fertilized with 21 pounds of Kainit and a crop of potatoes grown upon in 1891, Plat 11 remained

idle, and was cultivated only sufficiently to keep down the weeds. No fertilizers were applied, and no crop was grown upon Plat 11 in the year 1891, it being a vacant strip between the last potato plat and the tomato plats adjoining, and was used as a "turning row." In the spring of 1892, it was again "broken up" and planted in potatoes at the same time and in the same manner and received the same cultivation as the other plats.

No fertilizers, whatever, were applied to Plat 11, yet it produced 114.8 pounds of potatoes, while the other unfertilized plat (No. 5) which had produced in 1891, 243.5 pounds of potatoes, only produced 88 5 pounds. Now, supposing the natural fertility of the soils in plats 5 and 11 were the same in 1891 we are convinced that the natural fertility of the soil on Plat 11 was much below that of Plat 5, in 1891; by comparing the yield of these two plats for the year 1892, the wonderful effect of the exhaustion of the plant food naturally contained in a slightly recuperated, "worn out" soil by the production of a single crop becomes strikingly apparent. But this effect becomes much more marked if we compare Plats 10 and 11, making even a very small allowance for the effect of the fertilizer applied to Plat 10. The supreme folly of attempting to renovate a a worn-out soil by the use of commercial fertilizers alone, while cultivating the soil and removing the crops therefrom, is here so c early demonstrated that it needs no further argument.

The profit and loss account is fully set forth in the table, but is rendered almost valueless by the failure of the crop; but even under these circumstances, we find that the use of potash and phosphoric acid combined, gave us, on Plat 3, a net profit at the rate of $4.65, and on Plat 8, a net profit at the rate of $1.06 per acre. The Kainit Plats, Nos 1, 6 and 10, in one respect, show the same comparative results as in 1891—Plat 1 showing the largest, and Plat 10 the smallest yield, but the difference is much greater in 1892 than in 1891. In the crop of 1892, the net profit on Plat 1 is at the rate of $4.13 per acre; on Plat 6, a loss of $3.20, and on Plat 10, a loss of $4.20 per acre. We are satisfied that this difference was not caused wholly by the difference in the amount of Kainit applied to each of these plats, but is to a large extent attributable to the difference in the natural fertility of the soil. The Nitrate of Soda, as in the experiment of 1891 seems to have had no beneficial effect whatever.

TABLE C.

Showing the Results of Cutting the Seed Potatoes in the Production of the Crop.

Number of Plat.	Fertilizers used.			EARLY ROSE.								WHITE STAR.							
				Whole.		Halves		Quarters.		3 Eyes.		Whole.		Halves.		Quarters.		3 Eyes.	
	Kainit.	Nitrate of Soda.	South Carolina Dissolved Bone.	Large.	Small.	Large.	Small.	Large.	Small.	Large.	Small.	Large.	Small.	Large.	Small.	Large.	Small.	Large.	Small.
	Lbs.	Lbs	Lbs	Lbs	Lbs	Lbs.	Lbs	Lbs.	Lbs.	Lbs.	Lbs	Lbs	Lbs.	Lbs.	Lbs.				
1		....	....	21.2	3.1	8.0	2.3	3.7	1.7	5.6	3.0	14.4	3.2	9.5	3.1	7.4	2.8	14.6	3.1
2	42	8.33	....	11.8	4.3	8.7	2.3	3.5	2.0	2.5	2.4	10.4	3.8	10.7	3.1	9.7	2.3	10.0	3.4
3	42	......	21	7.7	2.6	11.3	3.1	5.8	3.1	9.5	2.1	11.7	2.7	15.1	3.1	15.4	2.2	14.6	4.2
4	42	8.33	21	9.5	2.6	4.4	1.2	1.3	1.5	[illegible]	2.2	10.2	3.1	12.0	2.1	11.8	3.3	[illegible]	[illegible]
5	Nothing			6.1	3.4	2.7	2.4	1.1	2.0	6.6	3.2	11.3	3.8	4.7	3.9	4.7	3.0	3.2	4.8
6	31½	....	......	9.9	2.9	3.6	0.9	1.9	1.7	2.8	1.9	6.4	3.2	6.3	2.0	4.2	2.2	7.8	[illegible]
7	31½	8.33		[illegible]	3.7	5.9	1.3	1.0	2.5	2.0	2.2	6.8	3.0	5.4	2.2	3.0	2.3	3.7	3.5
8	31½		21	9.8	[illegible]	6.8	1.1	3.8	3.5	[illegible]	1.5	13.3	2.4	7.5	3.2	9.7	2.1	8.9	[illegible]
9	31½	8.33	21	12.0	5.6	4.8	3.4	2.6	2.5	5.9	3.5	13.5	3.7	5.5	2.5	10.7	3.4	13.3	3.5
10	21	....	....	5.5	5.5	1.3	1.8	2.4	1.7	3.0	2.9	4.4	3.2	3.5	2.5	3.0	2.0	2.0	1.8
11	Nothing			13.8	5.5	3.6	2.2	1.6	2.2	3.6	2.8	6.9	3.2	9.8	3.5	3.9	3.1	4.0	4.0
	Total			118.7	44.5	61.1	25.8	28.7	24.4	51.7	31.0	112.8	35.3	90.0	31.2	83.5	28.8	93.4	41.0

TABLE C.—Continued.

Number of Plat.	Fertilizer Used.			Beauty of Hebron.								Total.		
				Whole.		Halves.		Quarters.		3-Eyes.				
	Kainit.	Nitrate of Soda.	South Carolina Dissolved Bone.	Large	Small	Large	Small	Large	Small	Large	Small	Large	Small	Total
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
1	42	......	......	5.1	3.2	4.9	3.2	5.2	2.8	5.8	3.4	105.4	34.9	140.3
2	42	8.33	......	6.9	1.7	3.9	0.9	2.9	1.4	5.7	2.8	86.7	30.4	117.1
3	42	......	21	6.1	2.7	5.3	1.9	6.1	1.8	14.8	4.2	126.4	31.0	160.4
4	42	8.33	21	13.4	2.1	3.0	1.1	4.0	1.9	3.7	3.4	89.[illegible]	29.0	118.4
5	Nothing		......	4.0	2.8	3.2	2.1	1.2	1.0	4.2	3.5	53.0	35.5	88.5
6	31½	......	......	5.7	2.2	1.9	1.7	1.9	2.2	5.4	3.8	57.8	28.5	86.3
7	31½	8.33	......	4.0	2.4	2.8	1.8	0.7	0.8	2.3	1.9	48.7	28.6	77.3
8	31½	......	21	7.5	4.1	4.7	1.4	3.3	2.2	13.9	3.3	95.1	40.9	136.0
9	31½	8.33		9.8	2.7	6.7	2.1	6.8	2.6	7.1	5.2	98.7	40.7	139.4
10	21			4.2	2.[illegible]	3.2	1.3	3.4	3.3	6.3	4.6	42.2	33.4	75.6
11	Nothing		......	5.5	2.8	7.4	5.4	5.1	3.0	7.1	4.8	72.3	42.5	114.8
Total	......		......	72.2	29.5	47.0	22.9	40.6	23.0	76.3	40.9	......	......	......

The comparative yield of large and small potatoes by planting the tubers whole, in halves, quarters, and cut to one eye in each piece.

From an examination of the footings of the columns in Table C. it appears that in the Early Rose and White Star varieties the whole potatoes produced the greatest amount of large tubers, and the quarters the least. In the Early Rose, the halves produced more large potatoes than either the quarters or single eyes, while in the White Star the single eyes produced more than either the halves or quarters. In the Beauty of Hebron variety, the single eyes produced the greatest amount of large tubers, the whole, halves and quarters following in the order named. In the experiment of 1891, the Beauty of Hebron was the only variety in which the whole potato produced more than the single eyes. In the record of that expeirment the following statement appears: "The table in the case of the Beauty of Hebron seems to favor the planting of the whole potato, but it is believed that under the same conditions, the same results would appear, as in the Early Rose and White Star." In the experiment of 1892, the same conditions were secured by making the rows a little closer together, thus avoiding the "old stony fence row," and the results show the correctness of the opinion then expressed. If we take into consideration the nourishment supplied by the "seed" tubers to the plants produced by the whole potato during their early growth, and at the time the change was being made in the source of plant food and charge the plants produced by the whole potato with this advantage, we believe the results secured by cutting the seed potato will agree, in almost every particular, with that obtained in the experiment of 1891.

It is almost the invariable rule that the greater the yield, the less is the ratio of small to large potatoes, therefore, that method of preparing the seed and planting, and the method of fertilizing which will produce the largest yield, and pay for the fertilizer used, are the methods which should be followed.

Table D. shows the yield, the increased yield and the per centage of increased yield for the two years, and will help the reader in comparing results.

TABLE D.

Showing the Yield, Increased Yield and Percentage of Increased Yield for the Years 1891 and 1892.

Number of Plat	Fertilizers Applied. Kainit.	Nitrate of Soda.	South Carolina Diss. Bone.	Total Yield in the Year 1891.	Increased Yield in the Year 1891.	Total Yield in the Year 1892.	Increased or Decreased Yield in the Year 1892.	Percentage of Increased Yield in the Year 1891	Percentage of Increased or Decreased Yield for the Year 1892
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		
1	42	....	....	332.25	87.75	140.40	51.90	35.78	58.64
2	42	8.33	....	350.75	106.25	117.10	27.60	43.45	31.18
3	42	....	21.00	520.50	276.00	160.40	71.90	112.88	81.24
4	42	8.33	21.00	445.00	200.50	118.40	28.90	82.00	32.65
5	Nothing.			244.50		88.50			
6	31.50			311.25	66.75	86.30	2.20	27.30	02.48
7	31.50	8.33		271.75	27.25	77.30	11.20	11.14	12.65
8	31.50		21.00	425.75	181.00	136.00	47.50	74.02	53.65
9	31.50	8.33	21.00	462.25	217.75	139.40	50.90	89.06	57.51
10	21.00 ...			238.00	[illegible]	75.60	12.90	09.71	14.57
11	Nothing.					114.80	26.30		29.71

Taking the experiments of 1891 and of 1892 together, we find a very remarkable agreement, even to minute details, and from the results of these experiments, confining our conclusions to the peculiar character and conditions of the soil upon which the experiments were conducted, we conclude that the best results in commercial fertilization, as tested, will be secured by a combination of Potash and Phosphoric Acid in the ratio of 2 to 1.* That there is no material benefit, but an actual loss in the use of Nitrate of Soda; that the best results in the preparation of the "seed" can be secured by so cutting the tubers that each piece will produce one strong vigorous stalk, and by planting from two to four pieces in each hill, according to the distance the hills are apart.

Experiments in the Use of Commercial Fertilizers in Growing Corn at the Several Out-Stations.

In obedience to the order of the Board of Regents, Out-Stations for experimental purposes were established in different parts of the State as follows: One at Martinsburg, in the county of Berkeley; one near Buckhannon, in the county of Upshur; one at Selden, in the county of Wood, and one near Buffalo, in the county of Putnam. One acre at each of the out stations in Berkeley, Wood and Putnam, and three fourths of an acre in the county of Upshur were set apart for experiments in growing corn. The land at each of the stations in the counties of Berkeley, Wood and Putnam was divided into sixteen plats, each plat being one rod wide and ten rods long and containing one sixteenth of an acre. The land in Upshur was divided into fifteen plats, each one rod wide and eight rods long, containing one twentieth of an acre. The experiments on these plats are being conducted for the purpose of determining the comparative merits of Kainit, Muriate of Potash and Sulphate of Potash as potash fertilizers in growing corn. The plats were divided into three series of four plats each. Four plats at each station were unfertilized and reserved as "checks" to determine the effects of the fertilizers on the others. As a basis from which to calculate the increased or decreased yield, the yields of the two unfertilized plats on each side of and adjacent to each series, were added together and divided by two. The fertilizers were applied when the corn plants were about three inches high, by sprinkling one-half of it along the rows and sowing the other half broadcast over the plats.

*NOTE.—In this experiment we have used Kainit, containing 14 per cent. of Potash; Dissolved Bone containing 14 per cent. of Phosphoric Acid and Nitrate of Soda, containing 15 per cent of Nitrogen and applied it at the rate of 840 lbs. of Kainit, 420 lbs. S.C. Dissolved Bone and [illegible] lbs. of Nitrate of Soda per acre. This formula gives us at the rate per acre on Plat 1, 117.6 lbs. of Potash. On Plat 2, 117.6 lbs. of Potash and 25 lbs of Nitrogen. On Plat 3, 117.6 lbs. of Potash and 58.8 lbs of Phosphoric Acid, and on Plat 4, 117.6 lbs. of Potash, 25 lbs of Nitrogen and 58.8 lbs. of Phosphoric Acid. If Muriate of Potash containing 50 per cent. of Potash, or Sulphate of Potash containing 25 or 50 per cent. of Potash is used, it will require a much less quantity to furnish the requisite amount of Potash; and the same rule will apply to all fertilizers.

In determining the actual amount of potash, nitrogen and phosphoric acid which was applied to each plat, it is necessary to know that the Kainit used contained 14%; the Muriate of Potash 50% the Sulphate of Potash nearly 52% of Potash. The Dried Blood contained 12% of nitrogen and the South Carolina Dissolved bone 14% of Phosphoric Acid. The tables show the amount and kind of each fertilizer used.

The long continued drouth in the counties of Berkeley and Upshur has so materially affected the results of the experiments in these counties as to render them almost valueless, standing alone. Unless we should supply the necessary moisture by irrigating adjacent plats, it is impossible to determine with any degree of accuracy the effects which were caused by the drouth. Comparing this with the crops of other years, omitting altogether the factor of fertilization, we know that the effects have been very disastrous. Farmers are well aware of the fact that a liberal application of fresh stable manure, followed by a dry season, often proves very injurious to the growing crop, causing what is known as "burning out." In the experiments under consideration, it seems that the use of commercial fertilizers has generally produced the same effect and proved injurious to the growing crop. Had the required conditions of moisture been fulfilled, the results of fertilization, no doubt, would have been radically different and very satisfactory. We regret that we have no record of the temperature and rainfall at any of these out-stations, save one, as such data would enable us to trace more accurately the effects of drouth, and the effects of fertilization accompanied by drouth. These experiments emphasize the remarks of Prof. A. W. Harris in the Experiment Station Record of January, 1893 in regard to the importance in all such tests of accurately noting the temperature of the atmosphere, the moisture and other physical conditions of the soil.

We are apt to conclude that an experiment is a failure if it does not produce the beneficial results anticipated. There is some reason for this conclusion among farmers who are looking alone for immediate profits and are not seeking for scientific facts which will enable them to understand and make available the laws of nature, which govern every profitable investment in agriculture. A failure is often as valuable as a success, as it is as important to know what not to do as to know what to do, and if we do the proper thing, and the results are not satisfactory, we desire to know why?

TABLE F.

Showing the Results of the Application of Commercial Fertilizers in growing Corn at the Out-Station at Martinsburg, Berkeley County, in charge of George W. Buxton, Esq.

Number of Plot.	Fertilizers Applied. Kainit.	Muriate of Potash.	Sulphate of Potash.	Dried Blood.	S. C. Dissolved Bone.	No. Pounds Ear Corn.	Yield per Acre.		Increased Yield per Acre.		Value of Increased yield per Acre.	Cost of Fertilizer per Acre.	Profit per Acre.	Loss per Acre.
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Bu.	Lbs.	Bu.	Lbs.	Dolls.	Dolls.	D'l.	Dols.
17	Nothing.			......	......	52.50	12	00	...	...	......	......		
18	33.33			......	......	52.50	12	00	...	-66	-0.47	2.80		3.27
19	33.33			16.66		43.25	[illegible]	[illegible]	3	4	-1.53	8.13		9.66
20	33.33				33.33	52.50	12	00	-0	-66	-0.47	6.53	....	7.00
21	33.33	...	......	16.66	33.33	70.00	16	00	3	4	1.53	11.86	....	10.33
22	Nothing.		......	......	......	60.75	13	62	....	....	....	......		
23		9.33	....	....	....	43.25	9	62	-2	34	[illegible]	[illegible]		[illegible]
24		9.33	....	16.66	......	43.50	9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
25		9.33	......	....	33.33	49.75	11	26	-1	00	-0.50	6.71	....	[illegible]
26		9.33	......	16.66	33.33	69.00	15	54	3	28	1.70	12.04		10.34
27	Nothing.			......	......	47.50	10	60	....	..	......	....	....	....
28			9.00	......	......	60.00	13	50	5	26	2.68	3.74	...	1.06
29	......	....	9.00	16.66	......	43.25	9	62	1	38	0.77	9.07	...	8.30
30	.....	....	9.00	....	33.33	41.75	9	38	1	14	0.60	7.47	....	6.87
31	......	......	9.00	16.66	33.33	43.00	9	58	1	34	0.74	12.80	....	12.06
32	Nothing.		......	......	......	25.50	5	58	....	....	....	......	....	....

At the out-station in Berkeley, the drouth began early, and continued almost throughout the season.

By an inspection of Table E., it will be seen that the yield on one-half of the fertilized plats is below that of the unfertilized plats; the average decreased yeild being 1.9 bushels, while the average increased yield of the other half of the fertilizers plats is 2.67 bushels per acre. The largest decreased yield is on plat 19, where we have a combination of Kainit and dried blood, being at the rate of 3 bushels and four pounds per acre, while the smallest decreased yield is on plat 18, where we used Kainit alone, and on plat 20 where we combined Kainit and S. C., Dissolved Bone being at the rate of 66 pounds of corn per acre. The increased yield of the first two series of plats, the first where Kainit, and the second where Muriate of Potash is used to supply the potash. is confined to the plats on which the comple fertilizers were used, Nos. 21 and 26. Yet these two plats have a higher rate of loss per acre than any of the other plats in these two series. The total decreased yield of each of the first two series of plats is very nearly the same; the Kainit plats being 2 bushels and 41 pounds, and the Muriate of Potash plats being 2 bushels and 36 pounds. There is an increased yield on all of the third seies of plats where the potash fertilizer is supplied by Sulphate of Potash, the most remarkable increase being on plat 28, where Sulphate of Pot sh alone is used. There is a very small difference in the increased yield of the other plats of the third series. The addition of Dried Blood and S. C., Dissolved Bone, either separaely or combined seeming to have but little effect, and the complete fertilizers in this case did not produce the marked effect which it did on plats 21 and 26.

The average yield of the plat upon which Kainit was used as a fertilizer is at the rate of 12 bushels and 33 pounds per acre.

The average yield of the plats upon which Muriate of Potash was used as a fertilizer, is at the rate of 11 bushels and 52 pounds per acre.

The average yield of the plats upon which Sulphate of Potash was used as a fertilizer is at the rate of 10 bushels and 52 pounds per acre

The cost of the potash fertilizers was: Kainit $2.80, Muriate of Potash $2.98, Sulphate of Potash $3.74 per acre.

TABLE F.

Showing the Results of the Application of Commercial Fertilizers in Growing Corn at the Out-Station at Buckhannon, Upshur County, in chargeof Alvin M. Ligget, Esq.

Number of Plat.	Fertilizers Applied. Kainit.	Muriate of Potash.	Suphate of Potash.	Dried Blood.	S. C. Dissolved Bone.	No. Lbs. of Ear Corn.	Yield of corn per acre.		Increased yield per acre.		Value of increased yield per acre.	Cost of fertilizer per acre.	Profits per acre.	Loss per acre.
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Bu.	Lbs.	Bu.	Lbs.	Dols.	Dols.	Dols.	Dols.
16	26.66					[illegible]	28	[illegible]	[illegible]	[illegible]	9.57	2.80	6.77	
17	26.66			13.50		[illegible]	22	20	15	[illegible]	6.71	8.20	...	1.49
18	....					[illegible]	8	[illegible]						
19	26.66				27.00	[illegible]	[illegible]	[illegible]	28	00	14.00	6.58	7.42	
20	26.66			13.50	27.00	[illegible]	44	[illegible]	36	[illegible]	18.00	11.98	6.02	
21		7.50				[illegible]	16	40	7	50	3.86	3.00	.86	
22	.....	7.50	..	13.50		[illegible]	21	[illegible]	12	[illegible]	6.43	8.40	..	1.97
23	.....					[illegible]	8	[illegible]						
24		7.50			27.00	[illegible]	[illegible]	50	20	[illegible]	10.43	6.78	3.65	
25	.....	7.50	....	13.50	27.00	[illegible]	[illegible]	50	28	[illegible]	14.43	12.18	2.25	
26	.....	....	7.00			[illegible]	[illegible]	20	-6	30	[illegible]	3.64		[illegible]
27			7.00	13.50		[illegible]	[illegible]	[illegible]	3	30	1.86	[illegible]		10.90
28	.....	....	....			[illegible]	8	40						
29	.....	.....	7.00		27.00	[illegible]	4	20	4	[illegible]	[illegible]	7.42		9.56
30			7.00	13.50	27.00	[illegible]	37	[illegible]	[illegible]	[illegible]	9.43	12.82		3.39

In the experiment in Upshur county, the plats are eight rods long and one rod wide and contain eight square rods or one-twentieth of an acre each, and are laid off in three series of five plats each; the middle plat of each series being unfertilized. In the calculations the yield of the unfertilized plat is made the basis, and the increased or decreased yield of all the fertilized plats in each series are determined by the difference between the fertilized and unfertilized plats of that series. These plats are all on a hillside having a southeastern exposure. The soil is a dark red clay loam, and was in pasture last year. The latter part of the season was very dry, there being no rainfall after the 20th day of July until after the crop had matured.

By reference to the table, we find that in the first series of plats where Kainit was used to supply the potash fertilizer, Kainit alone on plat 16 increased the yield 19 bushels and 10 pounds. By the addition of 13 and ½ pounds of dried blood (plat 17) the increased yield is reduced to 13 bushels and 30 pounds, depriving us of the profit of $6.77 per acre which plat 16 gave us, and creating an actual loss of $1.49, the whole injury amounting to $8.26 per acre. On plat 19, we add to the Kainit 27 pounds of S. C. Dissolved Bone, and secure an increased yield over the unfertilized plat at the rate of 28 bushels, and an increased yield over plat 16 at the rate of 7 bushels and 60 pounds worth $3.93 at an expense of $3.73 (the cost of the S. C. Dissolved Bone used), leaving a net profit of 20 cts. per acre in the use of the S. C. Dissolved Bone.

On plat 20 where all three of the fertilizers are applied, we have an increased yield at the rate of 36 bushels per acre, giving us, by the application of dried blood, an increased yield over plat 19 at the rate of 8 bushels per acre worth $4.00. The Dried Bloood cost at the rate of $5.40 per acre thus causing an actual loss by its application of $1.40.

In the second series of plats where Muriate of Potash is used to supply the potash fertilizer, we find that muriate of potash alone (plat 21) gives an increase yield at the rate per acre of 7 bushels and 50 pounds and a net profit of 86 cents per acre.

By the addition of dried blood (plat 22) we have an increased yield of 12 bushels and 60 pounds per acre, but an actuul loss of $1.97 per acre, causing an actual loss of $2.83 per acre. On plat 24, we have used Muriate of Potash and S. C. Dis. Bone combined, and have an increased yield at the rate of 20 bushels and 60 pounds. By this combination, we have an increased yield over plat 21 at the rate of 13 bushels and 10 pounds worth $6.57. The S. C. Dissolved Bone cost at the rate of $3.78 per acre; hence, we have a net profit by reason of this combination of $2.79 per acre. On plat 25, we again combine the three kinds of fertilizers, and have an increased yield over plat 24 of 8 bushels, being exactly the same increased yield for the addition of the dried blood that we obtained in plat 20, and the same net loss by its use of $1.40.

In the third series of plats, we encounter several difficulties which are inexplicable. By a very close inspection, it was impos-

sible to discover any material difference in the natural fertility of the soil on any of the three series of plats, yet the unfertilized plats of the first two series produced at the rate of eight bushels and 60 pounds each per acre, while the unfertilized plat of the third series produced at the rate of 18 bushels and 40 pounds per acre or more than twice as much. Notwithstanding the apparent increase of the natural fertility of the soil in the third series of plats, as shown by a comparison of the yields of plats 18 and 23 with plat 28, we find that all of the fertilized plats of this series, except plat 30, failed to produce as much as the unfertilized plat, and fell far below the yield of any of the other fertilized plats. Did the application of Sulphate of Potash to these plats cause this decrease? On plat 26 the application of Sulphate of Potash alone gives us a decreased yield at the rate of six bushels and 20 pounds per acre. On plat 27, by adding the Dried Blood, we increase the yield over plat 26, 2 bushels and 40 pounds, but have a decreased yield from plat 28 of 3 bushels and 50 pounds per acre. By adding S. C. Dissolved Bone to the Sulphate of Potash on Plat 29, we have an increase over plat 26 of 2 bushels per acre, but a decreased yield from the unfertilized plat of 4 bushels and 20 pounds per acre. Here we have recovered a part of the loss sustained on plat 26 by the addition of nitrogen on plat 27, and the addition of phosphoric acid on plat 29, but in neither case has the gain been sufficient to pay for the additional fertilizers applied. On plat 30, we combine the potash, nitrogen and phosphoric acid, and have a very decided increased yield, but not enough to pay for the fertilizers used. As the Sulphate of Potash seems to have had no beneficial effect combined with either Dried Blood or S. C. Dissolved Bone, did it contribute to the increased yield when combined with both? Or should the combination of Dried blood and S. C. Dissolved Bone be credited with the entire increased yield on plat 30? We are inclined te think that in this experiment the use of Sulphate of Potash is not only a complete failure, but it is the cause of very serious loss.

The average yield of the plats upon which Kainit was used as a fertilizer, is at the rate of 33 bushels and 15 pounds per acre.

The average yield of the plats upon which Muriate of Potash was used as a fertilizer is at the rate of 26 bushels and 30 pounds per acre.

The average yield of the plats upon which Sulphate of Potash was used as a fertilizer is at the rate of 19 bushels and 50 pounds per acre.

TABLE 6

Showing the Results of the Application of Commercial Fertilizers in Growing Corn at the Out-Station at Selden, Wood Conty, in charge of S. S. Stone, Esq.

Number of Plat.	Fertilizers Applied. Kainit.	Muriate of Potash.	Sulphate of Potash.	Dried Blood.	South Carolina Dissolved Bone.	No. Lbs. of Ear Corn	No. of Lbs. of Fodder.	Yield Per Acre.		Increased Yield per acre.		Value of Increased Yield per acre.	Cost of Fertilizers per acre.	Profits per acre.	Loss per acre.
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Bu	Lb.	Bu.	Lb.	D	Dols.	Dols.	Dols.
49	Nothing					[illegible]	[illegible]	[illegible]	20					....	...
50	33.33	.....	......	......	......	219	262	50	4	8	00	4.00	2.80	1.20	...
51	33.33	......	......	16.66	.....	293	257	66	68	24	64	12.45	8.13	4.32	......
52	33.33	.....	......	.....	33.33	217	256	49	42	7	38	3.77	6.53	.....	2.76
53	33.33	.....	.....	16.66	33.33	286	248	65	26	23	22	11.66	11.86	......	.20
54	Nothing		.....	.....	.....	183	188	41	58	....	......	......	......	......	..
55	.....	9.33	......	....	......	230	233	52	48	2	44	1.31	2.98	......	1.67
56	......	9.32	.....	16.66	......	355	262	81	18	31	14	15.60	8.31	7.29	..
57	......	9.33	......	......	33.33	276	282	63	14	13	10	6.57	6.71	......	.14
58	......	9.	......	16.66	33.33	397	298	90	52	40	48	20.34	12.04	8.30	..
59	Nothing					255	[illegible]	58	20						
60	...		9.00			[illegible]	[illegible]	50	60	7	30	-3.71	3.71		7.45
61	......	......	9.00	16.66	......	343	253	78	28	20	8	10.05	9.07	.98	......
62	......	.....	9.00	......	33.33	189	268	43	14	-15	6	-7.54	7.47	......	15.01
63	......	......	9.00	16.66	33.33	412	269	94	20	36	0	18.00	12.80	5.20	......
64	Nothing		......	......	......	301	260	68	56	......	......	......	......	......	......

The out-station in Wood county, is located at Selden, on the Ohio river, and is situated on the second or upper bottom lands. The soil is alluvial and consists of a dark sandy loam.

The average yield per acre of the unfertilized plats Nos. 49 and 54 is 42 bushels and 4 pounds. On plat 50 by the application of Kainit alone at the rate of 533 pounds per acre, we increase the yiled 8 bushels and have a profit of $1.20, and on plat 51 by adding thereto Dried Blood at the rate of 266½ pounds per acre at a cost of $5 33, we increase the yield over plat 50, 16 bushels and 64 pounds, worth $8.45, giving us a net profit by the use of Dried Blood of $3 12. By a combination of the two fertilizers, we have an increased yield of 24 bushels and 64 pounds at a cost for fertilizers of $8 13 and a net profit of $4.32 per acre. On plat 52, we add to the Kainit, S. C. Dissolved Bone at the rate of 533 pounds per acre, costing $3 65, decreasing the yield 32 pounds below the yield of plat 50 where Kainit alone was used; not only consuming all the profits of that plat, but causing an actual loss of $2.76 on the plat to which it was applied, making a total loss on the plat on which it was used of $4 93. On plat 53 we have a combination of Kainit, Dried Blood, and S. C., Dissolved Bone, and if we give each of these fertilizers credit for what they have produced on plats 50, 51 and 52, reducing the pounds to decimals of a bushel, we have for the Kainit 8 bushels. For the Dried Blood 16.91 bushels and for the S. C, Dissolved Bone —.46 bushels. Hence, we have 8+16.91— 46=24.45 as the yield of plat 53 But in this calculation, we have made no allowance for the injurious effect the S. C. Dissolved Bone had upon the productive powers of the Dried Blood. Suppose it had the proportional effect on the Dried Blood as we have shown that it had on the Kainit, then we must charge it with decreasing the productive power of the Dried Blood .96 of a bushel, which added to the .46 would give us 1.42. We then have 8+16.91 −1.42=23 49 bushels as the increased yield of plat 53. By reference to the table, we find that the actual increase is 23 bushels and 22 pounds, or 23.31 bushels, a difference of only .18 of a bushel, or 12.6 pounds per acre showing in both cases that the dissolved bone not only failed to produce any increase, but actually dimished the yield.

In the second series of plats for the potash fertilizer, we have used Muriate of Potash. On platt 55, by the use of Muriate of Potash alone, we increased the yield at the rate of two bushels and 44 pounds per acre, but sustain an actual loss of $1 76 per acre. On plat 56, we add the Dried Blood and increase the yield over plat 55 at the rate of 28 bushels and 40 pounds, and an increased yield over the unfertilized plats at the rate of 31 bushels and 14 pounds per acre. Here, by combining the Dried Blood with the Muriate of Potash, we not only recover the loss sustained by the use of the latter alone, but have a net profit of $7.29 per acre. The combination of S. C. Dissolved Bone with Muriate of Potash, seems not to have had the injurious effect it did when combined with Kainit, but on the contrary has been beneficial by paying for itself and recovering for us nearly all the loss sustained by the use of Muriate of Potash

alone (See plats 57, 55 and 52.) It seems to have been still more beneficial when combined with both Muriate of Potash and Dried Blood, as in plat 58. But the increased yield of plats 56, 57 and 58 may have been caused in part by the increase in the natural fertility of the soil of these plats, and this assumption seems to be strongly supported by the fact that of the two unfertilized plats at the beginning and ending of this series, the latter (plat 59) produced 16 bushels and 32 pounds per acre more than the former (plat 54). If this assumption should be true, then the apparent increase as the result of the application of S. C., Dissolved Bone, and the apparent superiority of Murate of Potash over Kainit as a fertilizer would entirely disappear. Corrected upon the basis of this assumption, the yields per acre of plats 56, 57 and 58 would be reduced by about 4, 8 and 12 bushels respectively, giving us a corrected increased yield on plat 56 of 27 bushels and 14 pounds, on plat 57 of 5 bushels and 10 pounds, and on plat 58 of 28 bushels and 48 pounds per acre. Upon this corrected basis, we find that the Muriate of Potash, as well as the S. C. Dissolved Bone, as applied on plats 55 and 57, gave no profits whatever, but caused an actual loss, while on plats 56 and 58, the Muriate of Potash combined with Dried Blood, seems to have had the effect of increasing the yield, but it is very duobtful whether such increased yield was sufficient to pay the cost of the potash fertilizer

In the third series of plats, we use Sulphate of Potash to supply the potash fertilizer. From an inspection of plats 60 and 62 it seems that the application of Sulphate of Potash and S. C. Dissolved Bone have each caused a decrease in the yield of each of these plats at the rate of about 7½ bushels per acre. Supposing that the nitrogenous, combined with the potash fertilizer produced the same effect on plat 61 that it did on plat 51, which was at the rate of 16 bushels and 64 pounds per acre: then we will have on plat 61 an increased yield at the rate of 3 bushels and 14 pounds per acre to be credited to the use of Sulphate of Potash when combined with the Dried Blood. The Sulphate of Potash applied to this plat cost $3.74 the increased yield of 3 bushels and 14 pounds is worth $1.60, leaving a net loss of $2.14 caused by the use of Sulphate of Potash.

In plats 63 and 64, we encounter a very important new factor. These two plats were in clover sod at the time the ground was "broken up" at the beginning of these experiments. If we assume that all of the plats of the third series, without the clover, were of the same natural fertility, and that plat 59 truly represents the natural fertilfty (an assumption which we think is well founded), then on plat 64 which had no other fertilizer, we have for the clover an increased yield of 10 bushels and 36 pounds per acre. Now, by subtracting this increased yield caused by the clover, from the yield of plat 63, we find the increased yield caused by the commercial fertilizers on this plat to be 25 bushels and 34 pounds per acre. Assuming that the Dried Blood produced substantially the same effect on this plat that it did on the other plats to which it was

applied, we have for the nitrogenous fertilizer an increased yield of 16 bushels and 64 pounds per acre, which leaves 8 bushels and 40 pounds of the increased yield to be credited to the potash and phosphoric acid. Assigning the Sulphate of Potash the same increased yield (3 bushels and 14 pounds) that we did on plat 61, we then have on this plat an increased yield of 3 bushels and 14 pounds for the Sulphate of Potash and 5 bushels and 26 pounds for the S. C. Dissolved Bone per acre, neither of which would pay the cost of the fertilizer to which it is credited.

The average yield of the plats upon which Kainit was used as a fertilizer is at the rate of 58 bushels per acre.

The average yield of the plats upon which Muriate of Potash was used as a fertilizer is at the rate of 71 bushels and 68 pounds per acre, caused, no doubt, by the natural increased fertility of the soil, and to the remarkable effects that Nitrogen produced on this series of plats, and not by the Muriate of Potash.

The average yield of the plats upon which Sulphate of Potash was used as a fertilizer, is 66 bushels and 48 pounds per acre, the increased yield resulting from the same causes as existed in the Muriate plats.

TABLE H

Showing the Results of the Application of Commercial Fertilizers in Growing Corn at the Out-Station at Buffalo; Putnam County in Charge of M. V. Brown, Esq.

Number of Plot	Fertilizers Applied. Kainit	Muraite of Potash.	Sulphate of Potash	Dried Blood.	South Carolina Dissolved Bone.	No. of Pounds of Ear Corn.	No. of Pounds of Fodder.	Yield per Acre.		Increase Yield per Acre.		Value of Increased Yield per Acre.	Cost of Fertilizers per Acre.	Profits per Acre	Loss per Acre
	Lbs	Lbs.	Lbs.	Lbs.	Lbs.	Lbs	Lbs.	Bu.	Lbs.	Bu.	Lbs	Dols	Dols.	Dols.	Dols.
17	Nothing		...			305	262	69	50	....	....	.....	.....	.....	...
18	33.33					270	266	61	50	—6	20	—3.14	2.80	...	5.94
19	33.33	.		16.66		331	243	75	46	7	16	3.83	8.13	...	4.30
20	33.33	.			33.33	282	207	64	32	—3	38	—1.77	6.53	...	8.30
21	33.33		.	16.66	33.33	292	200	66	52	1	18	—0.63	11.86	....	12.49
22	Nothing		...		.	296	207	66	20			.	...	.....	.....
23	.	9.33	.			295	222	67	30	0	40	0.28	2.98	....	2.70
24		9.33	.	16.66	.	307	260	70	12	3	52	1.66	8.31	.....	6.65
25	....	9.23		.	33.33	336	232	76	56	9	66	1.97	6.71	....	1.74
26	....	9.33		16.66	33.33	308	272	70	28	3	38	1.77	12.04	...	10.27
27	Nothing				.	295	209	67	30	.	.	..	....	.....	.....
28	...	..	9.00			283	270	64	48	6	60	—3.43	3.74	....	7.17
29	.	..	9.00	16.66	..	295	195	67	30	—4	08	—2.05	9.07	...	11.12
30	.	...	9.00		33.33	302	246	69	2	2	36	—1.25	7.47	...	8.72
31	.	..	9.00	16.66	32.32	315	262	72	0	9	32	0.23	12.80	..	12.57
32	Nothing	.	..		.	331	270	75	46	..	...	.	......	..	....

The land upon which the experiment was conducted in Putnam county, is Kanawha river bottom. The soil is alluvial in character and is a dark clay loam. The experiments made thereon are of an unsatisfactory character. Mr. Brown states that the "fertilizers were applied June 10th, when the corn was nearly knee high." This, we think, fully accounts for the unfavorable effect produced by the fertilizers, and shows that to be effective and beneficial, the plant food should be applied so as to be available in the earliest stages of plant growth. From an inspection of this table, it will be seen that one half of the fertilized plats produced a decreased yield, while none of them produced an increased yield sufficient to pay for the fertilizers applied. The ground upon which this experiment was conducted has been abandoned and no more experiments will be made upon it, (the location upon this farm having been changed) therefore, the table is only valuabluable as showing that it is very bad practice to apply commercial fertilizers to growing corn after the corn is "knee high."

The foregoing are the first in a series of experiments which it is proposed to carry on at the out-stations and continue through several years. Although there are many important facts shown in these tables, which would seem to indicate very strongly the kind and character of the plant food which should be supplied to the various soils treated, yet from one experiment alone, we will not attempt to draw any definite conclusion.

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Agricultural Experiment Station

MORGANTOWN, W. VA.

ADDRESS AND NOTES ON

SHEEP.

(By A. D. Hopkins

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AN ADDRESS ON PROFITABLE LINES OF SHEEP HUSBANDRY FOR WEST VIRGINIA.

DELIVERED AT FARMERS INSTITUTES IN KINGWOOD, LAUREL POINT, MOUNDSVILLE AND WELLSBURG.

BY A. D. HOPKINS.

Mr. President and Members of the Institute:

On this occasion I shall not address you as Entomologist of the Station, but as a sheep breeder and wool grower I shall mention some conclusions from my personal experience and observations regarding the sheep industry of this State, and will indicate certain lines of the business which, in my opinion, offers the largest profits to the average sheep owners in different sections.

Within the last three years, I have had occasion as a member of the Station Staff to visit or pass through nearly every county in the State. Although my duties were mainly to observe the conditions in regard to insect depredations, my interests in the development of the sheep industry of our State, and my experience of some twenty years in the breeding and care of sheep, in connection with other farm products, led me to observe closely the agricultural conditions of each county and sections visited. In comparing the conditions found with those observed in noted sheep growing regions in Kentucky, Ohio and Pennsylvania which I had previously visited, and with those recently observed in grazing sections of Wales, England, France, Germany and Switzerland, my impression regarding the possibilities offered in West Virginia, in certain lines of sheep husbandry, are most flattering.

Hancock, Brooke, Ohio, Marshall, Wetzel and Tyler counties form a section of the State where fine wool sheep have been kept on most farms as one of the leading features for many years. The fertile lands, elegant blue grass sods; the flocks of the best type of fine wooled sheep, and the quantity and quality of the wool produced, together with the prosperity and influence of those who have given special attention to this line of sheep husbandry, are evidences that this section is especially adapted to sheep, and are examples of the beneficial results to be gained from the general practice of keeping them.

Harrison, Lewis, Upshur and Gilmer counties form another section, where the same results have been gained from the breeding and feeding of Southdown and Shropshires, and other middle and long-wooled sheep and their grades for market lambs and mutton. Portions of Mason, Greenbrier, Monroe, Berkeley and Roane counties, and certain other sections of the state are equally noted for their blue grass pastures and profitable flocks of sheep, and are further examples of the profits and beneficial results the industry yields in different sections of the state. In fact, we find in our Mountain State all of the natural requirements necessary for profitable sheep husbandry in the line which will best supply the demands of our accessible markets. In the sections mentioned above, the majority of the owners of the land have appreciated and utilized these requirements to good advantage. The owners, however, of a large portion of the cleared land of the State have failed to do so, and we find widely differing conditions resulting from following, and the failure to follow, lines of farming, and methods of management, best suited to the requirements and environments.

I have invariably found that the land in sections of the State where live stock, and especially sheep, have been kept as the leading feature since the land was cleared, has improved rather than diminished in fertility and that the people as a rule are prosperous and influential. On the other hand, I have found, with few exceptions, that where a system of plowing and growing grain has been followed, the land has become poorer each year, and the owners are anything but prosperous. I can truthfully say that I have seen hundreds of farms in different sections of the State which were naturally as good as those in the fertile regions mentioned, but through persistent cropping and bad management, they had become not only unprofitable but an expense to the owners. Such farms, I am grieved to say, are only too frequently met with. The well kept fertile ones often found adjoining them, proving that this condition is not the fault of the soil, but the fault of the owners and their methods of farming.

That a system of plowing and cropping the hills and mountains of our State does not, and never will pay, we certainly have evidence in the existing conditions resulting from the practice. That a system of grazing, and the judicious breeding and management of sheep on the same land, will reclaim the exhausted soil and improve the new, at a large profit to the owners, we also have proof in the poorest farms which have been reclaimed in this way, and in the fertile regions mentioned.

We admit that there are small sections in different parts of this State where the conditions are favorable for the profitable growing and marketing of grain, hay, tobacco, etc. There are many farms along the Ohio river between Wheeling and Huntington, and near cities and large towns in other portions of the State, on which the growing of large and small fruits, and general market gardening will be found most profitable. With these few exceptions, however, it is my conviction that the remainder of the State is better adapted to a system of grazing, to

sheep husbandry, the dairy, and to the growing of large fruits, than to any other lines of agriculture.

In consideration of the above facts, and the possibilities offered in certain lines of sheep husbandry adapted to the conditions found, I am confident that, as our people appreciate more fully these possibilities, and as those in other States who desire to change their flocks to new and better localities, realize the opportunities offered, our sheep industry will make rapid progress, and in time take the lead for producing certain desirable qualities of both wool and mutton. All that is required, in my opinion, to bring about the above results, is that intelligent, progressive farmers should realize the possibilities of sheep husbandry in West Virginia as a money making business. We have intelligent farmers, and we believe that they will realize this requirement; in fact, many are already discovering that there are opportunities on the farms of our mountain State, equal to the average opportunities in the new or western states, or in towns, or large cities, where so many of our young men of push and energy have gone, not always to succeed.

PROFITS OF SHEEP HUSBANDRY IN WEST VIRGINIA.

That sheep under the present management, yield a larger profit than any other product on the average West Virginia farm, we have evidence in the answers to the following questions sent to correspondents in different sections of the State: "Do you consider sheep as profitable as any other farm product, if not, what is more profitable?" Ninety-one answered that sheep paid the largest profit, while three answered in favor of the dairy, one in favor of cattle, and one in favor of cattle and sheep combined. Speaking from my own experience of ten years on a farm in Jackson county, and eight years on a widely differing farm in Wood county, I can say positively that sheep paid me a larger profit on the money invested than any other product; the proof being found in a system of farm accounts and records kept with the different crops and live stock during the time mentioned. The account with sheep during eighteen years shows a profit of 50 per cent. on $3,006 invested in the sheep, and 55 per cent. on $996.20 cost of feed, pasture and attention; a total of 105 per cent. on the investment. The account with cattle of all kinds during the same time only shows a profit of 5 per cent. on $8,100 invested, and no profit on $1,050 cost of feed, pasture and attention. The account with wheat for four years on the Wood county farm shows a profit of only $1.77 on the four crops, and as the wheat was sold, about one-eighth of its value must be charged to it for fertilizer ingredients removed from the soil; therefore, there was a decided loss when it was marketed.

From the results, as shown by these accounts, and the accounts kept with other farm products, I arrived at the following conclusions:

1st. The largest profit in money, and the greatest benefit to the farm was derived from sheep.

2nd. The least profit and the greatest loss to the farm was in the growing of wheat for market.

3rd. Cows and poultry paid a profit on the investment, and their value to the farm is a considerable item.

4th. Large and small fruits paid large profits on time and money expended.

5th. The growing of some corn and oats, and all of the hay necesary for the stock, the purchase of corn, corn fodder, bran, linseed and cotton seed meal to supply the deficiency in the feed grown, paid a handsome profit on the cost.

6th. That a system of farm accounts and records, have been of inestimable value to me in showing conclusively which lines of agriculture, and methods of farm management paid the largest profit on the time and money expended.

The fact that the keeping of sheep has been a profitable occupation in all civilized countries from the earliest records up to the present time, is evidence that the business will continue to be profitable in the future. Food and clothing are among the principal requirements of the people of a nation, and as sheep furnish the best material to supply both of these requirements, there will always be an active demand for certain qualities of wool and mutton, and the largest profits will be realized by those who can best supply them.

The question of how to best supply the demands of the present and future, is one of vital importance to the sheep industry of our State. Upon the proper consideration of this question depends to a great extent its prosperous development.

There is a demand for all grades of wool, from the finest Saxony and Silesian to the coarsest article used in the manufacture of carpets and rugs. There is also a demand for the different grades of mutton from the cheapest article to the best. These demands are best supplied by the growers who are situated in the countries, or regions, where the conditions are most favorable for the production of each at the largest profit on the investment. Thus, England is producing differet grades of mutton at a profit on some of the best and highest priced grazing land. In Australia, and certain of our western states, sheep are kept in the largest flocks possible, on extensive ranges of the cheapest land, where wool as the only object is grown at a profit. Therefore, the conditions found in different sections of each country, state or county, together with the prevailing demands in the accessible market, must necessarily be taken into consideration, in order that the owners of sheep in each may best supply certain demands, at the largest profit to themselves.

In consideration of the above facts, I have been led to study the demands of our most accessible markets, and the conditions found in different sections of the State, with a view of ascertaining the kinds of sheep and methods of management most likely to yield the largest profits and best results.

We find in the eastern markets a demand for every grade of wool and for many different qualities of mutton, and a rapidly increasing demand for better qualities of the latter. We find in our home markets a demand in the cities and towns for more home-grown mutton, and throughout the State an increasing demand for better grades of stock

sheep and breeding ewes, and for more thoroughbred rams of the mutton breeds with which to improve the stock. Which of these demands can best be supplied by the individual grower, each must judge for himself, but the fact is evident that the sheep industry of our State can no longer compete with the West, and with other countries, in the growing of certain grades of wool produced by inferior mutton sheep. It is equally evident that we can compete with any section of the country in the growing of first class mutton, in connection with the wool the best mutton breeds produce.

At one time in the history of the sheep industry of the eastern states, it paid better to kill the sheep and convert the fat into tallow, than it did to sell them to the butcher. Wool was then the primary consideration. The value of sheep for mutton was not taken into account. At the present time, in certain sections, and even on high-priced land, it is found that sheep kept for mutton alone will pay better than any other kind of farm stock. It is a demonstrated fact that it cost the eastern farmer less to produce a pound of mutton than it does to produce a pound of beef or pork; hence sheep will pay as well, if not better, than cattle or hogs, even if the wool only pays for the shearing. Therefore, taking everything into consideration, I believe for West Virginia, situated as it is within a day or twenty-four hours by rail from Pittsburg, Washington, Baltimore, Philadelphia or New York, that the growing and feeding of sheep for mutton as a primary object and leading feature of the farm, is a line especially adapted to the conditions and requirements found, and that the largest profits will be realized by those who give this branch of the industry special attention and judicious management.

In concluding that the growing of sheep for mutton as a primary object, offers better inducements and greater possibilities to the owners of sheep in our State, I do not mean that every one should make a business of fattening sheep for the market, but I do hope to impress my hearers who breed thoroughbreds, raise stock sheep, market lambs, or fat sheep, with the importance of keeping in view, the final result of a first class article which will command the highest price in the market.

I am informed by a prominent butcher of Brooklyn that the demand for mutton in the large cities is increasing very rapidly, and that the laboring class, as well as the wealthy, are learning to like mutton, and while the laboring and poor class are more particular about the price than they are of the quality, the best hotels and restaurants, and thousands of private families, who care more for quality than the price, are demanding more mutton and lamb of choice quality, and are paying fabulous prices for the best.

While in Kentucky in 1880, a prominent sheep and cattle breeder of Bourbon county told me that he had shipped a number of choice Southdown wethers to New York, the previous Christmas, by special order of a first class restaurant, and that the net cash price for each sheep returned to him was $15. I know of others in Virginia who get from 15 to 18 cents per pound for choice early lambs, and I also know parties who sold their lambs (from common ewes and Southdown rams) in one of our home markets last spring for five dollars each.

In glancing over the sheep market as far back as I have any record. I find something like this in all of the quotations: "choice to extra, scarce and in good demand. Fair to common, plenty, in poor demand, dull." As this has been the condition of the supply and demand of our markets in the past. it is not likely that there will be any trouble in the future about a sufficient supply of "fair to good," and, "common to fair." These grades come in competition with the common to inferior western dressed mutton, and western sheep, which will likely keep the price low enough for such grades to satisfy those who must economize in their purchases. "The choice to extra prime," and above are the qualities of which the supply is rarely if ever equal to the demand, and are qualities, the price of which in our eastern markets are not likely to be affected by competition with the wholesale cheap products of the west.

No state in the east offers better condition for supplying this demand for choice mutton at a large profit to the grower, than West Virginia To produce the best quality and finest flavored mutton, a hilly, well watered, well-shaded country in which the cultivated and native grasses, and a variety of wild forage plants flourish. is indispensable. This we have in every county in the state. Then, again, in order to transport the fat sheep and lambs to the cities already mentioned, place the mutton on the table of the epicure, and have it retain the the requisite qualities of the first class article. a reasonably short time must elapse between the time it leaves the farm and reaches the consumer, which may be easily accomplished by the accessible railroads passing through and penetrating different sections of the State.

Methods Adapted to Different Conditions: Taking our sheep industry as a whole. the breeding, rearing and feeding of sheep necessarily includes a variety of methods adapted to the different conditions found. We find valleys, mountain and forest ranges, on all of which both rich land and poor pastures are found. We find sections convenient to shipping facilities while others are quite distant from them Different sections, therfore, require different methods. One section is better suited to the breeding and feeding of the large mutton breeds, or to the purchasing of stock sheep to feed and fatten for the butcher. Other sections will be found specially adapted to the rearing of market lambs

In others, and especially in the highlands and forest ranges, and on poor hilly farms, the rearing of stock sheep; wethers to sell to the feeders and ewes to sell to those who are making a specialty of rearing market lambs will be found most profitable for all concerned. There are other sections, especially in the Pan Handle counties, where the growing of fine wool, as a primary object will be found profitable, and the breeding of stud flocks of merinoes to supply a demand in the western states for choice eastern bred rams, will be found advisable and profitable for those who have already established a reputation and a trade in this line. Nowhere in the world can a better quality of Saxony and Delaine wool be produced than in Hancock, Brooke, Ohio and Marshall counties It has been proven that the merinoes are especially adapted to that section, and owners of merino sheep there who have been successful with them, should be very cautious about discarding their favorites for the mutton

breeds, for, in many cases, unsatisfactory and disastrous results will follow an abrupt change from one branch of the industry to another. For those who, after due consideration of the matter, find it advisable to make the change, it should be done gradually and preferably by crossing rams of the mutton breeds on grade merino ewes, than to change abruptly to the mutton breeds.

Each of the above methods is adapted at certain conditions and requirements found in different parts of the State, but there is one branch of the industry which will be found adapted to all; that is, the breeding of thoroughbred rams of the different mutton breeds with which to improve the common native sheep.

The use of thoroughbred male of the mutton breeds best suited to the improvement of our native stock in the lines desired is, in fact, of the greatest importance. Our success in producing the best qualities of mutton and lamb depends more on the quality and blood of the sire than anything else, and I am glad to see that this fact is being realized more each year by the sheep owners of the State. Therefore, those who have a knowledge of the principles of breeding will find it profitable to themselves and a great benefit to the sheep industry of the State, to locate flocks of throughbreds in different sections, and devote their skill and and knowledge to the maintenance and improvement of the requisite qualities of the breed or breeds which are best suited to the requirements of each.

BREEDS OF SHEEP.

Having concluded that the growing of mutton as a primary object, and the production of the best quality of mutton as a special object, would yield the largest profit and the best results to a majority of those in the State who are engaged in the business of sheep husbandry, the next thing of importance to consider is the breeds and kinds of sheep best suited to the requirements.

The Common or Native Sheep.—While the so called native sheep are of no particular breed, they must necessarily be considered as one of the important elements in the business, from the fact that the common ewes are usually easily and cheaply procured, or in other words, they are the available raw material with which, by the aid of the more expensive thoroughbreds, valuable flocks may be soon bred up.

Our native common sheep, evidently have descended through successive generations from the first sheep introduced into Virginia in 1609, and those brought over later from all countries. Large, middle and long wool types came from England, small, mountain varieties from the highlands of Wales, England and Scotland, merino types from Spain, and mixed breeds from all countries. The majority of these pioneer sheep were no doubt unimproved varieties in their native countries. After their arrival here, they were interbred, crossed, and the blood of all types intermingled, thus forming common hardy types differing from any of the original ones, yet peculiarly suited to the changed conditions.

When the importation of improved breeds began, early in the present century, a gradual improvement commenced and has been continued

until at present, most of our common sheep show the effect of improvement in certain recognized lines. Thus the native common sheep of the northern portion of the State are mainly merino grades. Those in the central counties, and certain other sections, are principally Southdown and Cotswold grades. While in some of the mountain districts and southern counties unimproved descendants of the old pioneer stock predominate.

Like the native sheep of Great Britain and all other old countries, the native common sheep of West Virginia are usually adapted to the conditions under which they have been kept. They are the result of a mixture of different breeds, with no predominating or fixed characteristics to transmit to their offspring, aside from their hardy constitutions and adaptability to the sections in which they have been reared. Therefore, a cross with the pure bred ram, having certain desirable and fixed characteristics, shows a magical effect in the improvement of the first set of lambs, and if the use of thoroughbred sires is continued from generation to generation, the improvement will continue until the flock may be even better, for mutton and wool, than the pure breds.

It was from my earliest experience in breeding sheep that I learned the value of the common ewe in breeding up a valuable sheep for mutton and wool, by the use of thoroughbred sires. I find from my records that the second cross of Southdown rams and common ewes, produced sheep that weighed from 180 to 200 pounds at maturity, and the weight of the fleece was increased, from three pounds to ten and twelve pounds.

Many of our sheep owners do not seem to appreciate the value of our common native ewes, and the possibilities and profits to be derived from their proper improvement. I know instances where they have been sold to the drover, and what seemed to be better sheep were purchased in the city market to take their place. It was afterwards found that the new sheep were, either not adapted to the changed condition, or they were the means of introducing certain contagious diseases, which proved to be a future curse to the sheep industry of the region in which they were introdeced.

The Pure Bred Sheep:—The use of the pure bred sires is one of the first principles of success in any line of the sheep industry; therefore, every sheep owner should become familiar with certain facts regardieg pure bred sheep. By the term pure bred or thoroughbred sheep, we mean those which have descended through successive generations (without admixture of impure blood or blood of different breeds) from a breed having a fixed type and desirable characteristics which are transmitted with reasonable certainty to their offspring. They may be divided into two classes, one as recorded, the other as unrecorded.

The recorded ones are those having their names or numbers, and their pedigrees recorded in a record book kept by an association of breeders. The rules of the several record associations require that no animal shall be admitted to record unless satisfactory evidence can be furnished that it has been purely and honestly bred. The recorded sire is therefore to be depended upon fcr purity of blood, and if due judgment is exercised in their selection, the best results should be gained from their use in breeding up the common stock.

The unrecorded sheep may be a pure bred animal, or may not. The pure breds are those which have been carefully bred, and a private record kept of their breeding, but have not been presented for entry in the record book of the association. Others may be pure bred, but as there has been no record kept of their breeding, we can only depend on the statement of the breeder as evidence that they are.

In visiting or corresponding with breeders with a view of purchasing pure bred animals, it will be advisable for those who have not had experience to keep in mind the following suggestions:

In no case where it is possible to get breeding rams from reliable breeders should anything but pure bred ones be used.

It is the right of each breeder of thoroughbred sheep to think that his breed is the best, and it is his privilege to convince every other owner of sheep that he is right, if he can. Hence, the importance of becoming sufficiently informed regarding the characteristics of different breeds, that we may trust largely to our own judgment in making the selections.

No matter how long a pedigree a ram may have, or how many of his ancestors may have been recorded, he may be practically worthless on account of lack of individual characteristics, or from being overfed and pampered to make a premium show sheep. "Hot house rams" are often dear as a gift, to those who do not take extra care of their sheep.

As a rule, the best results will be gained by the average sheep owner from the use of breeding stock purchased from breeders who are careful to have high bred animals, but only give them ordinary feed and care. Such sheep may not look so well, but in most cases, they will be found to be worth four or five times more than those which have been fixed up for show and to attract the buyer.

Mutton Breeds of Sheep:—The several mutton breeds of sheep found on the British islands are of special interest to us, from the fact that we are indebted to them for the improvement we have been able to make in our flocks of mutton sheep. The large number of breeds and varieties of sheep found on the comparatively small area of these islands is very remarkable, and a study of the causes which brought about and established such widely varying types is very instructive. We find the large, coarse Romney Marsh sheep thriving on the low, marshy lands of the southern coast of Kent. We find the Cotswold, Lincoln, Leicester, Shropshire Down, Oxford Down, etc., on the best level and slightly rolling lands of England. The Hampshire Down, South Down, Dorset and Cheviot predominate on the hills and rough land. The Welsh mountain, the Scotch Black Face and many other highland and forest breeds are found admirably adapted to rocky highlands and heather pastures. In the north of Scotland, and on the Shetland and Orkney Islands, diminutive breeds are found "extremely hardy and capable of subsisting under great privations of food."

Thus, it will be seen that in each section where some peculiar conditions of soil, altitude, etc., predominate, one or more breeds of sheep are found with certain established characteristics specially suited to their environments.

English and Scotch farmers and growers with an experience of cen

turies oft repeated and dearly paid for, have found which class of sheep are best adapted to given sections of country, and they keep the sheep on the soil to which they are best fitted. Nature is no longer antagonized but instead, improvement follows where her footsteps lead, and sheep farming in Great Britain has been reduced to a science." In West Virginia, as in England and Scotland, we have widely varying conditions of valley, upland, mountain, forest, pastures, etc., each requiring different methods of breeding and rearing sheep for market. If we are to be guided by "the dearly paid for experience" of the British shepherds, we will not try to adapt the large valley breeds to poor, roughland pastures, but profit by their experience and select, as near as possible, that breed which it has been proven as especially adapted to the conditions and requirements in each case. We must remember that there is no single breed that will readily adapt itself to all conditions, and at the same time yield the best results, and that the different English mutton breeds, from which we select our breeding stock, have been bred up to their present standard of excellence for certain purposes and to suit certain conditions and requirements. Therefore, in the judicious selection of pure bred breeding stock with which to improve the native and purchased common sheep, it will be found advisable for each owner of sheep to study the peculiar condition of his farm, the demands of his most accessible markets, decide which line of sheep husbandry is best adapted to the conditions and requirements, gain some information regarding the characteristics of the different breeds of sheep, and then select, as near as possible, from that breed which is best suited to the farm and the methods to be followed.

WHY ARE THERE NOT MORE SHEEP KEPT IN WEST VIRGINIA.

The question may be asked if West Virginia is so well adapted to sheep husbandry, and there are such large profits realized in the business, why is it that we have so few sheep compared with the area of cultivated and grazing lands in the State? In reply I would say that the dog, the tariff discussion, unwise start in the business, improper management, and a failure to study and appreciate the possibilities the business offers, are the main and only causes I can see to prevent us from handling five millions of sheep instead of about five hundred thousand, as recorded by the last census.

The excuse of nine-tenths of the farmers for not keeping sheep, is a fear of the justly, but indiscreetly abused dog. It has been unfortunate, perhaps, for the advancement of sheep husbandry in this State, that the dog has been so generally discussed and abused by speakers and writers. We should quit saying so much about them and act on the principle that a good dog stays at home or with his master, that a bad dog will prowl around and get into mischief, and that a dead dog kills no sheep.

Another excuse for not keeping more sheep, is a fear that some change in the tariff laws will be ruinous or detrimental to the business. In my opinion, this tariff question, about which there have been continued discussions, is in reality to be compared with a molehill, which,

under the political microscope, is magnified into a mountain. We are told by Democrats that a tariff for protection is all wrong. We are told by Republicans that it is all right. Now, as it is impossible for any feature of the tariff to be all wrong, and at the same time all right, my advice to the West Virginia farmer is to keep all the sheep he can properly care for and take the chances. After all, *the tariff will not effect the price of choice mutton, and as it is proven that sheep will pay better than other stock if they had no wool, any change in the tariff should not be the least detrimental to the business.*

Another reason why there is not more sheep kept is the fact that in nearly every neighborhood at some time, some one or more farmers hearing of the large profit to be derived from sheep husbandry have rushed into the business and overstocked their farms, not having previous experience, they failed, and ever after condemned sheep as worthless stock, their experience preventing their neighbors from undertaking to keep sheep. If these same men had commenced with only a few, and increased their flocks as they learned the business, the opposite results would, in most cases, have been gained.

Therefore, before going into the business, it would be well for each farmer to consider the following rule: If you have never kept sheep and desire to do so, get five or ten ewes, and a good thoroughbred ram of some of the mutton breeds adapted to your farm, give them good attention and feed and increase or decrease as your experience and judgment dictates.

In conclusion, I will say that, in this address, I have endeavored to emphasize certain points relating to profitable sheep husbandry in West Virginia, which I beleive to be of importance to our farmers and to the agricultural development of the State.

1st That the greater portion of West Virginia is better adapted for sheep, the dairy, and large fruits than to any other lines of agriculture.

2nd. That sheep ar the best stock with which to improve exhausted and poor land, and that they will maintain and improve the fertility of new and well cared for lands.

3rd In proving from records of eighteen years that sheep paid better than any other product on two widely differing farms.

4th That generally speaking, the method most likely to yield the largest profits to flock owners, is the production of *first class market lambs and fat sheep* for home and eastern markets, as a primary object leaving wool as a secondary one.

5th. That sheep husbandry in West Virginia offers inducements to inteligent men of energy and ambition, which should be seriously considered before they leave the farm for *more risky and less profitable pursuits in towns and cities, or in pioneer life in new countries.*

Notes of Travel in West Virginia and Europe

EXTRACTS REFERRING TO SHEEP.

While traveling through a portion of Webster county in July, 1890. I inquired of a farmer why there were not more sheep kept in that county, as it seemed to be so well adapted to them. His reply was "sheep are about the only thing we can sell for cash, the consequence is when we get hard up, we sell our sheep and spend the money. That is one reason why there are not more sheep kept here."

During an investigation tour through Hardy, Hampshire, Grant and Pendleton counties in May, 1892, I found extensive forests of pine timber which had been killed by insects (the destructive pine bark beetle.) While it is a fact that pine usually grows on thin land, it is as a rule a sandy well drained soil on which sheep do remarkably well. I found that most of the pine land in this region was well adapted to grass. If this land was cleared of the dead timber and sown to grass without previous cropping, then stocked with sheep and properly managed, the revenues derived from the sheep, would, in my opinion, more than recompense for the loss of the timber. In some of the valleys, near these pine covered hills and mountains, the land is extremely rich and adapted to the growing of an abundance of feed of all kinds, and where the sheep bred on the piney highlands could be fattened for market. In one of these rich valleys, the Moorefield valley in Hardy county, I visited an estate where three hundred and fifty tons of hay, five thousand bushels of oats, five thousand bushels of corn and two thousand bushels of wheat had been grown the previous season. The live stock at that time numbered 250 horses and 70 head of cattle. This estate of about 2,000 acres of valley land and some 8,000 acres of mountain lands, principally in timber, is owned by a young man from Brooklyn, New York, who had invested his inherited fortune in West Virginia ginia land.

The following extracts are from notes during an extended journey in June, 1892, up the Monongahela and Tygart's Valley rivers as far as Beverley in Randolph county; up the Dry Fork of Cheat river to its head, from the head of the Greenbrier river to its mouth, returning to Morgantown by the Chesapeake & Ohio, Ohio River and Baltimore & Ohio railroads:

At the hotel at Elkins, I met Mr. James Burrel, a Brooklyn New York butcher, who made the following statements in answer to my inquiries regarding the demand for mutton and sheep in the Brooklyn and New York markets.

"The working people as well as the wealthy people are buying more mutton every year; the latter paying high prices for a first class article. There will be a great demand for good mutton in our markets in the future. In the Brooklyn and New York markets, we do not want heavy sheep. We do not want them to dress over 50 to 75 pounds, and we want them blocky, meaty sheep with good backs and hams. We have millionares for customers, and they prefer mutton from the medium sized sheep. The best mutton we get is from Canada. They are long-wooled

lambs delivered here in September. We call the round bodied, blocky darkfaced sheep we get from the States "butterballs," and we want all we can get of them. We do not like to handle merino sheep. Their mutton as a rule is inferior. The western sheep also make poor mutton. Buyers object to the fat in the large fat sheep weighing 200 pounds and over, and we have to cut it out and sell it for tallow. Therefore, we do not like to handle that kind of sheep."

Mr. Bruce of the firm of C. & E. Bruce, was also at the hotel above mentioned and made the following statements:

"I spent three years in Australia on a sheep run where 150,000 sheep were kept, and I have now been in West Virginia three years grazing sheep and cattle and trading in them, (buying and shipping to eastern markets), in Randolph, Nicholas, Webster, Roane, Braxton and Clay counties. My observations and experience are that if mutton sheep were properly handled in West Virginia, they will pay 25 per cent. more on the investment than sheep do in Australia. My opinion is that West Virginia is better adapted to the growing of mutton sheep in connection with cattle than to any other farm product."

The firm mentioned above are owners of some of the best grazing land in the State, and are extensive breeders and dealers in sheep. Their property is located near the head of the Valley river in Randolph county. They had, at that time, 500 high grade Shropshire Oxford and Southdown breeding ewes.

At Hendricks in Tucker county, I was informed by Mr. M. F. Wiley, who is a buyer of sheep and cattle in Tucker, Randolph, Pendleton, Barbour and Grant counties, that although that section of the State was admirably adapted to sheep there were hundreds of farmers who did not keep them. In answer to the question—what does it cost to clear the ordinary mountain land and put it in shape for sheep? He said that it cost about $1.25 an acre to "hack the timber." By "hacking" is meant to girdle the trees which are left to die, then the under-brush is cleaned out. He said that most of the mountain land adapted to grazing can be made ready for sheep for about $3 to $5 per acre and that sheep would run on these mountain pastures from the middle of April, to the middle of November without extra feed.

The moutain ranges in this State, unlike those in most countries are not rocky and barren, but as a rule are fertile to the very summits, producing an abundance of wild forage plants in the forests, and the best of pasture grasses when cleared of the timber. In fact, I have seen on the very summit of the Allegheny mountains 4090 feet above the sea, some of as fine blue grass as ever grew, as will be seen by the following notes:

June 22nd, 1892. After ascending Dry Fork of Cheat on foot and horse back for about 30 miles from Hendricks, we spent a day and night at a logger's camp. The next morning I was furnished with a guide and we started out on horseback to explore the extensive forests of spruce. We first ascended East Rich mountain by a narrow, winding path, our horses having to frequently jump over logs lying across it. Near the summit, we came to some cleared grazing land, and while taking shelter from a thunder storm in the house of the owner of this

mountain farm, I obtained the following information from our host. Mr. S. K. Nelson, regarding the method of keeping sheep there.

"Sheep run in these mountains and do well. One man can care for one thousand five hundred sheep during the year. During the winter, they are kept principally on browse, especially when the ground is covered with snow. I can keep sheep on browse better than on hay. Sugar and beech are the best browse. We cut the trees all winter. One tree will usually be sufficient for ten sheep one day. I have kept sheep here five years, and I have never fed more than a sled load of hay and have given them no grain and they do well. I do not think one would lose over five per cent. of the sheep if properly managed, and one hundred ewes will raise nearly one hundred lambs. John Mulanax near here, kept about 800 ewes last winter."

After we left Mr. Nelson's, we traveled on some distance through a dense forest and came out into an open of several hundred acres in extent. Here the timber had been hacked several years previous and left to die and decay. The ground was thickly covered with fallen and decaying trunks of trees, among which, large numbers of sheep and cattle were grazing on some of as fine blue grass as I ever saw.

I was informed that these cleared lands are owned by parties in Virginia and this State who drive their cattle and sheep into these mountain pastures and ranges and place them in charge of herders who look after them during the summer and winter.

After traveling through a number of these mountain pastures, we descend the mountain to another logger's camp where we got our dinners; after which we commence the ascent of the Allegheny mountains. We passed through the spruce forest for about six miles to the summit of the mountain where we emerge into and pass through a "burnt district" for about three miles. This "burnt district" is in Pendleton county. The timber was first killed by a fire in about 1862, and has frequently been burnt over since, until now there is about 5000 acres clear of logs and stumps. Part of this land is covered with a dense growth of the thornless blackberry (*Rubus Millspaughii*), and hundreds of acres of it is found on which nothing but a species of fern* grows, while other portions are covered with grass. Two hundred cattle were then ranging there, and it was estimated that 1000 sheep could be easily kept on it through the summer.

Adjoining this "burnt district" where the land had been enclosed and kept clear of briars and trash, there were hundreds of acres of blue grass sod, which would compare favorably with the average sods in the blue grass regions of Kentucky. A species of fragrant fern called "sweet ferren"† was found here, which is considered a valuable forage plant. It is quite common in rocky places in open fields and I was informed that it was sometimes cut and cured like hay to feed the sheep in winter.

From this interesting region, we returned along the summit of the Alleghenies through forests, burnings and hacking until we reached the Sinks on Gandy Creek. This is a noted grazing region, which

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**Pteris aquilina*, L.

†*Aspidium fragrans*, (?) Swartz

takes its name from numerous depressions in the limestone formations and from a natural tunnel, which extends for about three quarters of a mile through a hill. Gandy Creek flows in and disapears at one end of this tunnel and rushes out at the other like a great spring.

All of the region lying on the head waters of Dry Fork and Laurel Fork of Cheat and the East Fork of the Greenbrier River including possibly 50,000 to 75,000 acres, is principally a limestone soil naturally adapted to blue grass Here, we find large tracts of land which have been cleared and are being cleared by the hacking and burning methods. The grass comes up naturally as soon as the timber or underbrush is sufficiently removed to allow the sun to get to the ground. Some of the first land that was cleared in this way is now free from stumps and logs and we find here some elegant blue grass grazing farms.

As evidence of the grazing capacity of these lands, I will give a statement of Mr. Isaac Boggs, of Preston county, whom I met near the Sinks on his return from looking after his cattle in this region. He said that the cleared grazing land here will keep one two year old steer to every three acres. That he had kept one hundred head of cattle through the summer on 324 acres of which only 275 were cleared. Also that Col. McClure had fattened 125 three and four year old steers on 440 acres. He says that they drive the cattle in about the middle of April and remove them about the middle of October

One tract of one thousand acres, that I examined personally, 600 acres of which had been cleared by the hacking method, was of special interest. Much of this so-called cleared land was covered with blackberry briars, fallen trunks of trees and stumps, yet there were 174 head of cattle, 30 sheep and 5 horses then on the place and all in excellent condition.

At present, this elegant grazing section is almost inaccessible. It is 25 miles from the nearest railroad, and we might say that far from roads of any kind, if they are all like the path by which we entered. However, this section is destined in the near future to be one of the best sheep grazing sections of the country, especially if the contemplated railroads are built through it. At present, there are not many sheep kept here on account of wild animals and dogs. While looking over the thousand acre range just mentioned, we found a dead sheep, which had been killed by a bear.

These grazing lands and ranges are nearly all at an elevation of between 3000 and 4000 feet In the winter, the snow falls quite deep, but with a hardy breed of sheep and some artificial shelter, there would, in my opinion, be no more difficulty in keeping them through the winter here than in the extreme northern States and Canada.

From my observations, and what I can learn, there are hundreds of thousands of acres in the mountains and highlands of our State nearly or quite as good for sheep as the region I just mentioned. True, most of the land is at present covered with valuable forests of spruce and hard wood, but this timber is being rapidly removed by numerous lumber and timber companies who are specially interested in present gains from the manufacture and sale of lumber. No doubt many of these companies will be glad to dispose of their land at a reduced price

when the timber is all removed: therefore, there will be excellent opportunities offered to open up large sheep ranges.

In descending the valley of the Greenbrier river, I passed through what had been a great pine region between Traveler's Repose and Dunmore, in Pocahontas county. The land where the pine had stood is like all other pine land, not very fertile, but admirably adapted to a small, hardy breed of sheep.

Little Levels, in Pocahontas county, is a fertile limestone tableland at an elevation of about 2250 feet and is surrounded by mountains on which the land is rich and especially adapted to grass and sheep. The land of the levels is also very fertile, and admirably adapted to the breeding and feeding of large breeds of sheep.

The level limestone region near Lewisburg, Greenbrier county, was found to be a large area of some of the best grazing lands in the State, which is also especially adapted to large breeds of sheep, to the raising of market lambs, and to fattening sheep for market.

TRAVELS IN EUROPE.

August 24, 1892. As we passed through North Wales on the "Zulu" fast train for London on the Great Western Railroad, the Welsh hills on which the Welsh mountain sheep are grazed, were observed in the distance. I was impressed with the resemblance of this section of Wales to certain localities in West Virginia.

As we pass out of Wales and into Shropshire, England, large numbers of sheep were observed grazing on the best level land. This county, so far as I could judge from what I could see from my apartment window, is a rich, level country, devoted largely to grazing sheep and cattle. Although the land seemed to be as fertile as it is possible for land to be, field after field was observed covered with a thick coating of manure. Passing through Shropshire, Stafford and Warwick counties, we enter Oxford, the home of the Oxford Down sheep. Large numbers of what appeared to be this breed of sheep were observed grazing upon the extremely fertile and flat grass lands. So far as I could see, Oxford like Shropshire is a level and almost flat country unlike any section I have seen in West Virginia, but resembling very much certain sections of northern Ohio. From Oxford we passed through Berkshire, Buckingham and Middlesex to London.

After spending a day and night at London, I left there on the night train for Paris by the way of New Haven and Dieppe. To my regret and disappointment, we passed through the South Down hills, in Sussex, the home of the South Down sheep, after night.

In passing through France to Germany, I did not see a single sheep; in fact, it was not until I had spent several days in the valley of the Rhine and was traveling by rail from Strassburg to Dresden, Saxony by way of Frankfort-on-the-Main, that I observed the first flock of sheep. That there are plenty of sheep in these countries, I well knew. I judged, therefore, that the sheep must be either kept housed, or were on the highlands and not in the valleys through which I had been traveling. That mutton was a favorite meat on the continent was evident from its

being on one or more of the bills of fare each day at the hotels where I had been stopping. The excellent quality of this mutton and the large proportion of lean meat on the cutlets (about three times as much as on the average American cutlets) made me particularly anxious to see some of the sheep. The first flock of sheep was observed at the highest altitude on the railroad between Frankfort and Dresden in Gotha. There were about one hundred in the flock, which were in charge of a shepherd and his dog. They were small sheep with jet black faces and white legs. In general appearance resembling our unimproved native sheep.

I spent four days in the Kingdom of Saxony, but was not fortunate enough to be able to visit one of the many noted flocks of sheep there, and had to content myself with a look at some premium Saxony wool which was shown me by the Director of the Experiment Station at Meissen.

Returning to Strassburg through Bavaria, by the way of Munich, and through the Black Forest in Baden, by way of Constance and Tryberg, I saw large flocks of sheep on the highlands, near the head of the Danube river.

While in Switzerland, I had an opportunity of examining one of the Alpine sheep which graze with the goats on the almost vertical pasture lands in this beautiful Alpine country. This individual was a small, black, muscular sheep with fine wool, and admirably adapted to the mountain pastures.

September 25. Upon my return to England by the way of Berne, Laon, Calla and Dover, and entering the county of Kent, I saw more sheep from the train in five minutes in Kent than I had seen during my travels of nearly 2000 miles in France, Germany and Switzerland. The pasture fields in England seem to be literally covered with sheep, and I can now realize how there can be over one sheep to every acre of cleared and grazing land in England, and that in some counties there is an average of five sheep to the acre. (In West Virginia, we only have an average of one sheep to every seventeen acres of cleared land).

September 26. After I had secured my steamer ticket at London and had taken the train for Liverpool, it occurred to me that as my steamer did not sail until the afternoon of the 28th, it would be just as well to stop off somewhere between London and Liverpool, and see something of the country. Passing through Middlesex, Hartford, Bedford, Northampton and Leicester counties, and into Nottingham county, I stopped off at the city of Nottingham in the evening, trusting to chance to find something of interest in that region. After engaging a room at the George Hotel, I made inquiry about the points of interest, and if it would be possible for me to visit a sheep farm in that county. I was referred to the firm of Mills & Gibbs as parties who could give me information regarding the agriculture and sheep industry of that portion of England, and the next moring I called at the office of the firm to obtain the desired information. Mr. Mills, who was the owner of a large estate at Ruddington Hall, about five miles from the city, gave me a letter to his manager at Ruddington. I, therefore, drove out to this place and after taking lunch with Mr. Gibson, the manager, we start out through a

driving rain to look at the stock. The Shorthorn cattle were the first examined, and from the cattle, we visited the sheep.

The Shropshires are the favorite breed and are bred and fed to a very high state of perfection. Some individuals were shown me which has cost "sixty guineas" (about $300). These sheep are kept on the best pasture and feed the farm can produce and receive a great amount of attention and care from a trained shepherd who is well up in the business. Therefore, every sheep is made to appear to the very best advantage. After examining a large flock of ewes which were being bred, we visited another pasture in which a flock of Dorsets ewes were found. These ewes were brought in Dorsetshire and bred to a Hampshire ram, so they would commence lambing in October to produce lambs for the Christmas market. Then they were to be bred again so as to produce another set of lambs in the spring, or early summer. From this field, we passed through large fields of mangolds, swedes, turnips, rape and cabbage which were being grown for the sheep. I was informed by Mr. Gibson that the sheep are first hurdled on the cabbage then on rape and flat topped turnips, followed by swedes, and that the mangolds are cut and fed to them in the winter. Farther on, a flock of great Lincolns were observed feeding on cabbage, a certain amount being apportioned to them each day by the use of hurdles.

Returning to the barn, we examined some mangolds which had been kept over from last year. They were found to be as sound as the day they were pulled. From here, we drove through beautiful fields surrounding the characteristic English country gentleman's home, Ruddington Hall, and I returned to Nottingham well pleased with what I had learned of the English methods of farm management and stock breeding.

Summary of Answers to Circular Letter.

For the purpose of gaining certain information regarding the sheep industry in different sections of the State, a list of questions were prepared and sent out in a circular letter to about 200 addresses selected from our mailing list. Reports were received from 46 counties, and from 127 correspondents who had some experience with sheep. Sixty seven had experience with more than one breed. Twenty eight had experience with one breed only, and thirty two had kept sheep, but had no experience with thoroughbreds.

The following table will show the number of votes each breed received for different purposes.

There were not a sufficient number of reports from any one county or section of the State to enable us to form any definite conclusions from the answers to the several questions; however the answers as here tabulated will serve to indicate the prevailing opinions on the subjects mentioned.

	Southdown.	Shropshire.	Cotswold.	Merinos—Spanish, Amer'n, etc.	Delaine Merino.	Black Top Merino.	Oxford.	Hampshire.	Leicester.	Lincoln.	Saxony.	Native.	Lincoln-Southdown Cross.	Merino-Shropshire Cross.	Merino-Southdown.	Dorset.
The number of votes for the Favorite ram to cross with common ewes to produce mutton sheep were...	64	26	11	4	2	..	1	1	1	1	..	..	1	1		
To produce market lambs	44	30	12	..	.	.	5	3	2	1	.	..	1	1	1	
To produce mutton and wool combined	24	27	19	11	5	1	7	1	.	4	..	..	1	..	2	.
Number of flocks of thoroughbreds reported	23	37	7	19	10	4	9	3	..	1	3	..	..	..	.	1
Breeds which seem to be favorites in counties from which reports were received.	45	30	7	22	4	2	6	.	1	..	..	2	1			
Predominating blood in improved grades as reported..	39	11	12	20	..	1	2	1	..	1	1	..	..	..	..	

The price of recorded rams as reported from different sections range from $5 to $75 or an average of about $25. The price for unrecorded rams as reported range from $2.50 to $35, or an average of about $12.

The prevailing diseases, parasites, &c., as reported, were as follows, their prevalence being indicated in the order in which they are here given: Catarrh, including what is termed rot, foot rot, grub in the head, body scab, paper skin, swelled jaw, ticks, stretches, diarrhea, head scabs, liver fluke, lung worms, anemia, murren, fits, maggots in wool, pulling wool, "neglect" and "starvation."

Ninety-one correspondents reported that sheep were more profitable than any other farm product. Three claimed the largest profit for

the dairy. One that cattle paid best, one that sheep and cattle combined were the most profitable, while thirteen did not answer.

It was my desire and intention to include in this bulletin descriptions and illustrations of the different breeds of sheep, with chapters on methods of management, feeding, treatment of diseases and other important subjects of interest to sheep owners. I have found, however to my regret, that owing to serious depredations of insects in our forests and on certain farm crops, together with my absence of about six weeks in Europe, my time has been so completely occupied with duties pertaining to the Department of Entomology that I could not devote the time necessary to complete the bulletin as I had intended. In fact, there has been so much published on these questions of late in government reports, and in the many excellent agricultural and stock journals, that in order to issue a bulletin containing much new or original matter that would be of special value to those engaged in the industry in this State, it will be necessary to make further research, investigation and experiments. Especially is this important in ascertaining the best breeds of sheep for different sections, in investigating the causes of different diseases and experimenting with remedies and preventives, in experimenting in the breeding and feeding of sheep and lambs, in the growing of roots and forage crops and the investigation of many other important subjects pertaining directly to the needs and to the advancement of the sheep industry in West Virginia.

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WEST VIRGINIA

Agricultural Experiment Station

MORGANTOWN, W VA.

CATALOGUE

OF WEST VIRGINIA

SCOLYTIDÆ and their ENEMIES.

APRIL, 1893.

CHARLESTON, W. VA
MOSES W. DONNALLY, PUBLIC PRINTER
1893

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CATALOGUE

OF

WEST VIRGINIA SCOLYTIDÆ and their ENEMIES.

With List of Trees and Shrubs Attacked.

BY A. D. HOPKINS.

INTRODUCTORY.

Damage Caused by Bark and Timber Beetles.

The immense damage to forest, shade and fruit trees caused by Bark and Timber Beetles belonging to the Scolytidæ family, together with the importance of the timber and fruit interests of West Virginia has made it seem necessary that we should study the habits of the different species found, and the extent and character of the damage caused by them. While only a portion of my time has been devoted to this study, sufficient evidence has been obtained to convince me that the destructive powers of these minute and apparently insignificant beetles are far greater than is generally supposed. Owing to their obscure habits and the great labor and difficulty of collecting and studying them, comparatively little has been known of the life histories of even the commonest kinds. Therefore, it is our desire to call the attention of owners of timber, and others who are interested in the preservation of our forests, to the great importance of a more extended knowledge of the number of species and the peculiar habits of each. Especially is a more general and technical knowledge necessary that some successful efforts may be made towards preventing the recurrence of widespread devastation of timber like that which has occurred in different sections of the country within the last fifteen years.

Since 1878, vast areas of timber in the spruce forests of Maine, New Hampshire, New York, New Brunswick and Canada, have died and become almost a total loss.* In West Virginia since 1880, the Black Spruce on more than one hundred thousand acres of land has died, causing the loss of at least one million dollars. Since 1888, an unprecedented death of trees has occurred among the dif-

*Packard. Fifth Report of the U. S. Entomological Commission. Chapter XVI. Page 811.

ferent kinds of Pine over an area of ten thousand square miles in West Virginia, Virginia and Maryland. Our magnificent Black Spruce forests, covering an area of over five hundred thousand acres, is again threatened, and if not checked will prove destructive to large areas of timber.

From my own observation during extended investigations in the West Virginia forests and from what I have seen of the habits of certain European species, and from information obtained from Oberforester W. Eichhoff and other high authorities on the subject in Germany, I am confident much, if not all, of the destruction of timber mentioned above has been due primarily to the attack of certain species of bark beetles.

Number of Species in the Family Scolytidæ.

According to Henshaw's lists and supplements of 1889, this family includes 169 described species. Numerous new species have since been discovered, until at present there are probably over 200 described and undescribed species in the different collections. The species taken by me in West Virginia since 1890 number 53 named and 27 unnamed and new species. These I have divided into three popular groups according to certain peculiar habits of the adult insect; namely: Bark-beetles, Timber-beetles and Twig-beetles.

Habits of Bark Beetles.

As a rule, the adults of this group of Scolytids prefer to enter the green or partly dead bark on unhealthy, injured or dying trees, stumps, logs and tops of broken branches for the purpose of making mines or galleries through the inner bark, in which to deposit their eggs. The minute white grub hatching from these eggs at once commence to feed upon the bark and usually proceed at right angles from the primary gallery and extend their mines through the bark until they have become full grown, when they form pupæ cases either in the outer sap-wood, inner or outer bark, according to the habits of the species. In due time the pupæ change to adults like the parent form, and each individual makes for itself an exit through the outer bark, thus the bark of a tree infested by bark beetles will be found pierced with innumerable round holes after the young beetles have fully developed and emerged.

The number of broods of bark-beetles vary from one to three according to the species and the favorable or unfavorable conditions for their propagation. They pass the winter in different stages. Some in the larval and pupal forms in the outer sap-wood or in the bark; others, as adults, concealed in the outer bark of living or dead trees. In this group, thirty nine species have been found belonging to the genera *Pityophthhorus*, *Dryocoetes*, *Tomicus*, *Scolytus*, *Chramesus*, *Polygraphus*, *Phloeotribus*, *Hylesinus*, *Phloeosinus*, *Dendroctonus* and *Crypturgus*.

While the majority of bark-beetles observed seem to prefer

to attack unhealthy, injured or fallen trees, there is at least one species (77) which seems to prefer attacking living, vigorous trees, and there are others which are capable of existing in perfectly green bark without being seriously inconvenienced by the flowing sap or turpentine. When they attack the bark of a living tree, their egg galleries and larval mines through the inner bark have the effect of checking the flow of sap, thus causing an unhealthy condition of the tree. Other species having a preference for trees in this condition are attracted to it and enter the bark to extend their winding galleries and the death of the tree is the certain result. In fact, many trees might resist the first attack sufficiently to recover and other trees having their health impaired from other causes might regain their original vigor, were it not for the bark-beetles which are ever ready to infest such trees and counteract all chances of recovery.

Habits of Timber-Beetles.

Timber-beetles like the bark-beetles prefer, as a rule, to attack trees impaired in health, or those which have been recently felled, yet there are species in this group which seem to prefer to attack living trees. So far as I have observed, they all have a decided preference for green or partly green wood in which to extend their "pin-hole" tunnels. These tunnels or galleries are made by the parent beetles for the purpose of forming proper receptacles for their eggs and favorable conditions for the future development of their young.

One class of this group consists of species belonging to the genus *Monarthrum*, *Gnathotrichus* and *Xyloterus*, according to my observation, deposit ther eggs in small excavations at more or less regular intervals along the sides of the galleries. These cavities are just large enough to accommodate a single egg, and the grubs or larvæ hatching from them proceed to enlarge and extend the cavity at right angles to the primary gallery. These side cavities or chambers are only enlarged sufficiently to accommodate the full-grown larvæ, pupæ and young beetles. When the young beetles have sufficiently matured, they come out of the side chambers into the main gallery, and the entire brood emerge from the original entrace made by the parent beetle.

Another class of this group consisting of species belonging to the genus *Xyleborus*, bore into the wood in the same manner as those just mentioned, but instead of depositing their eggs in cavities in the side of the galleries, they place them in groups within its walls. The young larvæ as a rule do not enlarge and extend the gallaries, but appear to feed upon a substance coming from the wood. Frequently eggs, larvæ of all stages, pupæ, young and fully matured beetles will be found together in one gallery. It also appears that the beetles do not necessarily emerge from the wood when matured, but may extend secondary and branching galleries in which they deposit eggs for another brood. One peculiarity observed with certain species of this class is the extreme small size of

the males which are seldom, if ever, found outside of the galleries in which they have developed.

There is another class consisting of species belonging to the genus *Platypus* which seems to partake of the habits of both of the classes mentioned above, for I have observed all stages from eggs to fully matured forms in the same mine, and I have also found the full-grown larvæ in side chambers evidently excavated by them.

The character of damage caused by all of the species of the timber beetles is principally that resulting from their boring through the green wood of saw-logs and standing trees. The round, black holes so common in lumber and timber termed "pin-holes" or "worm holes," while not all caused by Scolytids, they are to blame for certain kinds which render timber and lumber unmerchantable The discoloration of wood termed "bluing" is also largely the result of the galleries formed by the beetles in the green wood. The vacated galleries allowing air, water, and fungus germs to penetrate the wood of trees, logs, manufactured timber and lumber, not only cause the blue or colored condition, but a rapid decay of the wood. Twenty-five species belonging to this group have been observed.

Habits of Twig-Beetles.

The beetles belonging to this group attack the terminal twigs and small branches of living, dying and dead trees, in which they form galleries for the purpose of depositing eggs, and the larvæ feed upon the bark and wood. Species having this habit so far as I have observed belong to the genera *Hypothenemus* and *Pityophthorus*. Fifteen species belonging to this group have been observed.

The Clover Root-Beetle

Is a species belonging to the Scolytid family which may properly be called a root beetle to distinguish it from those having different habits. I have not yet met with this species in our State, but from the fact that it is a common clover pest in adjoining States, it will doubtless be found within our borders.

Special Investigations.

The destructive work of three species of Scolytids namely the Destructive Pine Bark Beetle (*Dendroctonus frontalis*), the Spruce Bark-beetle (*Polygraphus rufipennis*), and European Fruit Bark-beetle (*Scolytus rugulosus*), has demanded special investigation requiring long and difficult journies through the extensive forests, wild mountain regions, and other sections of the State. I have availed myself of the opportunity thus offered to not only study the habits of these destructive species, but to also collect and study other members of the family to which they belong. Many interesting facts relationg to the family and their natural enemies have been discovered and some important experiments are now under way to ascer-

tain the efficiency of certain methods of combatting the most pernicious kinds; one of which is the importation of enemies of European Scolytids to feed upon and reduce the numbers of the destructive American species.

These investigations and experiments are not yet sufficiently completed to justify the publication of a detailed report of the work and results. Therefore this catalogue of species observed, and summary of notes relating to their life history is sent out in advance of popular bulletins on forest and shade tree insects, which will contain full accounts and illustrations of the principal injurious and beneficial species and detailed reports of the investigations. It is also intended to serve in part as a catalogue of an exhibit collection of Scolytids and some of their enemies to be shown in the station exhibit by the Association of American Agricultural Colleges and Experiment Station at the World's Columbian Exposition at Chicago.

The Exhibit Collection.

Aside from showing the results of some special work in Entomology by the West Virginia Agricultural Experiment Station, the exhibit referred to is intended to illustrate as far as possible the character of the damage caused by Bark and Timber Beetles, and the individual species to blame for certain kinds of "pin-holes" in wood, certain kinds of mines or galleries in the bark and other peculiar damage to timber and lumber, such as "bluing" and premature decay, due to their boring in the green wood, and also to show some of the native and imported enemies which are being studied with a view of utilizing them in the destruction of the injurious Scolytids.

All of the species mentioned in this catalogue could not be shown in this exhibit on account of insufficient material for both it and the exhibit collection of forest and shade tree insects, to be shown with the forestry exhibit in the West Virginia building. It will also be understood that uniques and type specimens are too valuable to place in an exhibit collection.

The List of Insects.

All of the species mentioned in this catalogue have either been collected or bred by me since March, 1890, and the condensed reference to habits, collecting and breeding dates, localities, etc., are taken from my notes and records of observation.

The arrangement of the species of Coleoptera are according to Henshaw's list and supplements of 1889, without regard to changes which have been made since his list was issued. The Hymenoptera are arranged in families as near as could be according to Cresson's synopsis of 1887.

Where the species of Coleoptera and Hymenoptera are simply named generically, they are believed to be new species. If, upon further study, this is found to be a fact, they will be described and their names published in a subsequent list.

Where a species of predacious or parasitic insects is mentioned as being found with a species of Scolytid, it means that they were

found in the mines or galleries of the Scolytids, but no further evidence was had that they actually attack them. Where the word attack is used, I have evidence that they are actually enemies of the species mentioned in connection with them.

List of Trees and Shrubs.

The technical names of the trees and shrubs from which I have taken Scolytids has been made out and arranged by my assistant, Mr. W. E. Rumsey, from their common names as mentioned in my notes. Mr. Rumsey has also rendered efficient assistance in the preparation of specimens of the exhibit.

Acknowledgements.

For the first determination of the largest number of the species of Scolytids mentioned, I am under special obligations to Oberforester W. Eichhoff, of Strassburg, Germany, who is probably the best authority in the world on the systematic study of this family.

For the determination of Hymenoptera, I am under obligations to Dr. C. V. Riley, Messrs. L. O. Howard and William H. Ashmead, of the Division of Entomology at Washington.

For the first determination of Coleopterous enemies, I am indebted to Dr. G. H. Horn, of Philadelphia, and to Dr. C. V. Riley, of Washington.

For the naming and description of new species of Braconidæ, I am under special obligations to Mr. William H. Ashmead, of Washington.

I desire in this connection to mention the special kindness of the following named persons during my recent visit to Germany for the purpose of collecting and studying the enemies of European Scolytidæ: Mr. W. Eichhoff, of Strassburg, in giving valuable information and assistance by letters of introduction and otherwise during my investigations in the Alsacian and Lorraine forests. Oberforester Strohmeyer and his son, Mr. H. Strohmeyer, of Hagenau, Elsace, and Oberforester Pilz, of Albansweeler Lorraine, in accompanying me and giving special privileges in the forests of which they have charge.

During my stay in the Kingdom of Saxony, Mr. Camillo F. Schaufuss, Director of the Museum at Meissen, was specially kind in giving efficient aid in our search for the European Bark Beetle Destroyer,* in the King's forest near Moritzburg.

Through the kindness of the Curators of the Kensington Museum at London, the Museum d'Histoire Naturelle, at Paris, and the Museum at Berne, I was permitted to examine the study collections of Scolytids. I also availed myself of the opportunity of looking over Mr. Eichhoff's elegant collection of Scolytids of the World, in which many type specimens of American species were found.

*This popular name was given to Clerus formicarius by Mr. Schaufuss and myself while we were taking refreshments at a cafe in the Grasse Garten in Dresden, September 2. It was so named on account of the recognized predaceous habits of both the adults and larvae.

WEST VIRGINIA SCOLYTIDÆ

Collected and Bred March, 1890, to March, 1893.

Order COLEOPTERA; Family SCOLYTIDÆ.

1.* **Platypus quadridentatus**, Oliv.

TIMBER BEETLE.†

Enters green sap-wood near base of dying trees. Causes "pin-holes," hastens decay. Infests Black Oak, Chestnut.

Enemies 128? 129?‡

Adults July 29, 30.
Wayne and Wood counties.§

2. Platypus compositus, Say.

TIMBER BEETLE.

Enters green sap and heart wood. Causes "pin-holes" in wood, hastens decay. Infests Black Oak, Sugar Maple, Chestnut, Basswood, Magnolia, Red Elm, Beech, Wild Cherry.

Enemies 139.

Adults June 12; July 17, 21, 22, 29; August 4, 10; October 15; January 31. Pupæ July 21, 22. Larvæ July 21, 22; January 31. Eggs July 22; August 10.
Counties, Tyler, Kanawha, Wetzel, Monongalia and Wood.

3. Corthylus punctatissimus, Zimm.

TIMBER BEETLE.

Enters wood of green trees, causes the death of small trees. Infests sassafras.

Adult Oct. 14.
Monongalia county.

*Numbers in heavy type indicate that the specimen is shown in Exhibit collection.
†See page 123.
‡Refer to numbers in this list.
§Localities where collected.

4. **Monarthum fasciatum**, Say.

TIMBER BEETLE.

Enters green sap and heart wood of dying and dead trees, logs and stumps. Causes "pin holes,"* "bluing,"† and hastens decay. Infests Pine, White Oak, Black Oak, Basswood, Beech, Hemlock.

Enemies 142?

Adult Feb. 20; Mar. 2; April 14, 15, 17, 18; May 18; July 21; Aug. 6, 22; Sep. 3.

Wood, Wetzel, Tyler, Monongalia counties.

5. **Monarthum mali**, Fitch.

TIMBER BEETLE.

Enters green sap and heart wood of logs, stumps and dying trees. Causes numerous small pin holes. Colors wood dark. Hastens decay. Infests Pine, White Oak, Black Oak, Red Oak, Jack Oak, Elm, Beech, Maple, Chestnut, Basswood, Honey Locust, Yellow Poplar (Tulip), Buckeye, Morello Cherry, Red Cedar, Hemlock.

Enemies 128.

Adults Feb 20; Mar. 2; April 14 to 19; May 4, 8, 30; July 16, 20, 21, 24, 25, 29, 30; Aug. 1, 12, 22; Sep. 3; Dec. 6; Jan. 31. Pupæ July 21. Larvæ July 21. Eggs July 21.

Wetzel, Wayne, Wood, Hancock, Monongalia and Kanawha counties.

6. **Gnathotrichus retusus**, Lec.

TIMBER BEETLE.

Enters sap-wood. Causes pin-holes and bluing. Infests White Pine, also other Pines.

Adult from Virginia near W. Va. line, October 21.

Adult dead in White Pine wood, August 29.

Monongalia county and Virginia.

7. **Gnathotrichus materiarius**, Fitch.

TIMBER BEETLE.

Enters green sap wood at base of stumps and dying trees. Causes "pin-holes," "bluing," hastens decay. Infests Pine.

Enemy 131?

Adults May 18; July 13, 14; October 15; May 3; November 7.

Wood, Hampshire, Marion, Monongalia counties.

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*See page 124.

†See page 124.

8. **Pityophthorus minutissimus**, Zimm.

BARK BEETLE.*

Enters green and dead bark on injured and dead branches and tops of trees. Causes slight, if any, damage. Infests Black Oak, White Oak, Jack Oak, Chestnut Oak, Dogwood.

Enemy 114.

Adults June 13; July 29; December 24; January 27. Pupæ July 29. Larvæ July 29; February 12. Eggs July 29.

Wood and Monongalia Counties.

9. **Pityophthorus sp. a.**

BARK BEETLE.

Enters green bark of tops and branches injured or broken by storm. Hastens death of top and branches attacked. Infests White and other Pines.

Adults April 30.

Wood county.

10. **Pityophthorus pullus**. Zimm.

BARK BEETLE.

Mines under partly green bark on dying trees, branches and tops. Hastens death of trees? Infests Pines.

Enemies 149, 151.

Adults April 30; May 3, 4, 6, 9, 20, 30; September 5, 12. Pupæ May 30. Larvæ May 30.

Hampshire, Hardy, Wood and Monongalia counties.

11. **Pityophthorus, sp. b.**

BARK BEETLE.

Habits unknown. Collected on bark of dead Maple.

Adult May 27.

Monongalia county.

11a. **Pityophthorus plagiatus**. Lec.

Tomicus plagiatus, Lec. (A. D. H.)

BARK BEETLE.

Mines under green bark on tops and branches of injured and dying trees, broken branches, etc. Hastens death of injured trees. Infests Pines.

Enemies, 101.

Adults, May 3, 6, 18; October 10, 14.

Wood, Hampshire and Monongalia counties.

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*See page 122

12. Pityophthorus sparsus, Lec.
Tomicus sparsus, Lec. (A. D. H.)

BARK BEETLE.

Mines in green bark on tops of injured and dying trees, broken branches, etc. Hastens death of trees. Infests White Pine, also other Pines.

Adults, April 30; May 9; September 12. Pupæ September 12 Eggs April 30. Adults emerged July 1.
Wood county.

13. Pityophthorus cariniceps? Lec.

TWIG BEETLE.

Mining under bark and in wood of terminal twigs of young dying spruce. Damage unknown. Infests Black Spruce.

Adults, August 29.
Randolph county.

14. Pityophthorus confinis, Lec.

BARK BEETLE.

Mining in outer and inner bark on dead trees, and under green bark on injured trees Probably hastens death of trees. Infests Pines.
Enemy, 156.

Adults April 30; May 4, 6, 20; June 21, 24; July 13. Larvæ, Pupæ and adults October 14.
Wood, Hampshire and Monongalia counties.

15. Pityophthorus consimilus, Lec.

BARK BEETLE.

Mines under green bark on dying trees and injured shrubs or vines. Hastens death of shrubs. Infests Sumach, all of the species of the genus Rhus.
Enemy 155.

Adults June 27; July 22; August 4; November 8; October 15. Pupæ June 27; October 15. Larvæ June 27; October 15; December 7.
Wood, Kanawha, Tyler, Marion and Monongalia counties.

16 **Pityophthorus hirticeps** ? Lec.
(= ? *new species* A. D. H.)

TWIG BEETLE?

Mines under bark and in wood of terminal twigs on young trees. Damage unknown. Infests Black Spruce.

Adults August 29.
Randolph county.

17. **Pityophthorus sp. c.**

BARK BEETRE?

In bark of dying trees. Damage unknown. Infests Black Spruce. Enemy 94.

Adults June 23; August 29.
Randolph and Pendleton counties.

18. **Pityophthorus lautus**, Eich.

BARK BEETLE.

Mining under bark on injured branches and twigs. Damage unknown. Infests Pine.

Adults June 29: July 30. Larvæ July 30.
Wood county.

19 **Pityophthorus puberulus**, Lec.

BARK BEETLE.

Mining under bark on dead trees. Damage unknown. Infests Pine. Enemy 151.

Adults July 20.
Marshall county.

20. **Pityophthorus sp. d.**

TWIG BEETLE.

Mining in bark and wood of dying twigs on green trees. Seems to cause the death of the twigs. Infests Pines.
Enemies 83? 151.

Adults May 3; June 29; July 13, 30. Bred—Eggs May 3. Larvæ, Pupæ and Adults July 13. Larvæ July 13, 30.
Hampshire and Wood counties.

21 **Pityophthorus sp. e.**

TWIG BEETLE.

Mining in bark and wood of dying twigs on healthy trees. Probably kills twigs. Infests Pine.

Adults, Pupæ and Larvæ June 29.
Wood county.

22. **Pityophthorus tuburculatus**, Eich.*

BARK BEETLE.

Mining under bark of terminal twigs on young trees. Infests Black Spruce.

Adult bred Oct. 28.
Randolph county.

23. **Pityophthorus sp. f.**

TWIG BEETLE.

Infests Pine twigs.

Adults June 29.
Wood county.

24. **Pityophthorus sp. g.**

BARK BEETLE.

Mining under green bark on injured tops and branches. May hasten death of injured trees. Infests White Pine, also other Pines.

Adults April 30.
Wood county.

25 **Pityophthorus sp. h.**

BARK BEETLE.

Mining under bark on dead branches. Infests Apple.

Adults Dec. 4.
Monongalia county.

26. **Hypothenemus eruditus**, Westw.

TWIG BEETLE.

Mines in pith and wood of dead twigs and vines. Infests Honeysuckle.

Adults bred March 18.
Wood county.

27. **Hypothenemus sp. a.**

TWIG BEETLE.

Mining under bark on small dead branches. Infests Apple.

Adults Dec. 4; Oct. 23.
Monongalia county.

28. **Hypothenemus sp. b.**

TWIG BEETLE.

Mining in outer end of twigs on dead trees. Infests White Walnut, Black Walnut.
Enemy 116.

Adults Mar. 3; April 24. Bred April 25. May 30. Eggs May 30.
Monongalia county.

*So determined by Mr. Eichhoff.

29. **Hypothenemus sp. c.**

TWIG BEETLE.

Mining in buds and ends of twigs of cut branches. Infests Apple.

Adults December 4.
Monongalia county.

30. **Hypothenemus erectus.** Lec.

TWIG BEETLE.

Mining in pith and wood of vine. Infests Honeysuckle.

Adult bred April 19. Pupæ March.
Wood county.

31. **Hypothenemus sp d**

TWIG BEETLE.

Mining in bark and wood of dying twigs on healthy trees. Infests Pine. (P. inops.)

Adults June 29.
Wood county.

32. **Hypothenemus dissimilis.** Zimm.

TWIG BEETLE.

Mining in pith and wood of dead twigs. Infests Hickory.

Adults October 15.
Marion county.

33. **Hypothenemus sp e**

TWIG BEETLE.

Mining in pith and wood of twigs killed by twig girdler *Oncideres cingulata*. Infests Hickory.

Adults Oct. 15.
Marion county.

34. **Hypothenemus sp. f.**

TWIG BEETLE.

Bred from galls on oak twigs.

Adults Oct. 10.
Jefferson county.

35. **Hypothenemus sp. g.**

TWIG BEETLE.

Mining in twigs killed by oak pruner (*Elaphidion parallelum?*) Infests White Oak.

Adult Dec. 24.
Wood county.

36. Xyloterus retusus, Lec.

TIMBER BEETLE.

Enters green sap-wood of dying trees. Causes large pin holes. Hastens decay. Infests Large-toothed Aspen.

Adults Aug. 10.
Monongalia county

37. Xyloterus bivittatus, Kirby.

TIMBER BEETLE.

Enters green sap wood of logs, stumps and dying trees. Causes great damage to saw logs Produces pin holes. Causes "bluing" and hastens decay. Infests Black Spruce and Hemlock.
Enemies 138, 139 ?, 154 ?.

Adults May 8, 9; June 1: July 7, 8, 9, 11; August 30; September 1. Pupæ June 1; July 9. Larvæ June 1; July 9, 11. Eggs May 8, 9.
Tucker, Grant and Randolph counties.

38. Xyloterus scabricollis, Lec.

TIMBER BEETLE.

Enters green sap wood of dying pine trees. Causes "pin holes," "bluing" and hastens decay. Infests Pines.

Adults May 3, 4.
Hardy and Pendleton counties.

39. Xyloterus politus, Say.
(*Xyloterus unicolor*, Eich.)

TIMBER BEETLE.

Enters green wood of logs, stumps, dying trees and wounded places on green trees. Causes black "pin holes" in wood. Very injurious to outer portion of wood. Hastens decay. Colors the wood. Infests Beech, Black Oak, White Oak, Red Oak, Hemlock, Sugar Maple, Red Maple, Chestnut, Magnolia, Elm, Hickory, Ash, White Birch, Black Spruce.
Enemies 128, 140 ?.

Adults March 29, 30; April 12, 17, 29, 30; May 8, 9; June 1; July 10, 16, 24, 26, 29, 30; August 10. Eggs July 17. Adults emerging July 24.
Wood, Grant, Tucker, Hancock, Tyler, Wayne and Monongalia counties.

40. **Cryphalus n. sp.**, (Eich.

Flying.

Adult April 15.
Wood county.

41. **Xyleborus pyri**, Peck.

TIMBER BEETLE

Enters green sap and heart wood of logs, stumps, injured and living trees. Causes black "pin holes," a serious damage to lumber. Infest Hemlock, Beech, Birch and Red Oak.

Adults May 8, 9. Larvæ June 1. Eggs May 8, 9.
Grant county.

42. **Xyleborus sp. a.**

TIMBER BEETLE.

Enters wood of stumps. Causes black "pin holes." Infests Cedar.

Dead adult January 31.
Monongalia county.

43. **Xyleborus obesus**, Lec.

TIMBER BEETLE.

Enters green wood of logs. Causes large black "pin holes." Probably causes considerable damage to oak timber and lumber. Infests Black Oak, Beech and Hemlock.

Adult March 3; July 6, 8. Pupæ and larvæ July 6, 8.
Preston, Grant and Monongalia counties.

44. **Xyleborus celsus**, Eich.

TIMBER BEETLE.

Enters wood of logs and dying trees. Infests Hickory.
Enemy 160?

Adults April 30; May 20.
Wood county.

45. **Xyleborus fuscatus**, Eich.

TIMBER BEETLE.

Enters green wood near base of stumps and dying trees. Causes "pin holes." Hastens death of tree. Infests Black Oak and Hickory.
Enemy 163?

Adults July 10, 24, 29, 30.
Wayne, Grant, Wood and Monongalia counties.

46. **Xyleborus, sp. b.**

TIMBER BEETLE.

Enters green sap wood near base of dying trees and stumps. Causes numerous black "pin holes." Hastens decay. Infests White Oak, Chestnut Oak, Black Oak, Jack Oak. Enemy 165?

Adults July 7. 30; Jan. 27.
Wayne, Wood and Monongalia counties.

47. **Xleborus sp. c.**

TIMBER BEETLE.

Enters green wood at base of injured trees. Causes "pin holes." Hastens decay. Infests Jack Oak.

Adult July 29.
Wood county.

48. **Xyleborus sp. d.**

TIMBER BEETLE.

Enters green sap wood near base of dying trees. Causes numerous small "pin holes" in wood. Infests Black Oak, Hickory and Chestnut.

Adult July 10, 29; Sep. 3; Oct. 10.
Monongalia, Wayne, Grant and Marion counties.

49. **Xyleborus xylographus,** Say.
(*Xyleborus Saxesenii,* Ratz.)

TIMBER BEETLE.

Enters green wood on felled trees and injured or dying wood on green trees. Probably hastens death of injured trees. Infests Apple.

Adults, Pupae, Larvae, Eggs October 11; December 4, 6; March 2.
Manongalia county.

50. **Xyleborus, sp. e.**

TIMBER BEETLE?

Adult flying April 14.
Wood county.

51. **Xyleborus pubescens**, Zimm.

TIMBER BEETLE.

Enters green sap and heart wood of stumps, logs and dying trees. Causes numerous black "pin-holes." Hastens death of trees. Infests White Oak, Chestnut, Black Oak, Buckeye, Magnolia, Basswood, Cultivated Cherry, Honey Locust, Jack Oak.

Enemy 16?.

Adults April 11, 18, 27; May 1, 20, September 3; Adult, Pupæ, Larvæ, Eggs July 21, 29.
Wood, Wetzel and Monongalia counties.

52. **Xyleborus, sp. f.**

TIMBER BEETLE.

Enters green sap wood at base of dying trees. Causes "pin holes," "bluing." Hastens decay. Infests Pine.

Adults, Pupæ, Larvæ July 24.
Monongalia county.

53. **Xyleborus, sp. g.**

TIMBER BEETLE?

Adults Flying.
Wood county.

54. **Dryocoetes autographus**, Ratz.
(*Dryocoetes septentrionis*, Mann.)

BARK BEETLE.

Mines under green bark on logs, stumps and dying trees. Hastens death of injured trees. Infests Black Spruce. Norway Spruce.
Enemies 86, 87, 90, 124? 131?

Adults March 15, 26, 28, 29, 30, 31; May 8; June 18, 20. Pupæ August 29. Larvæ March 31; July 11; August 29, 30; September 1. Eggs July 11; September 1.
Randolph, Monongalia, Tucker and Grant counties.

55. **Dryocoetes, n. sp.**

BARK BEETLE.

Mines under green bark on stumps, logs and dying trees. Hastens death of trees. Infests White and Black Birch, Wild Cherry.
Enemies 124? 142?

Adults May 8, 9; July 7, 9. Larvæ May 8, 9. Eggs July 7, 9.
Grant county.

56. **Dryocoetes affaber?** Mann.

BARK BEETLE.

Mining under bark on dead trees. Infests Black Spruce

Adult July 9.
Grant county.

57. **Dryocoetes granicollis,** Lec.

BARK BEETLE.

Mining under green bark on stumps, logs, and dying trees. Hastens death of trees Infests Black Spruce.

Adults March 29; May 9; June 1, 24; July 9, 14; August 28, 29; September 1. Pupæ August 29. Larvæ September 1.
Randolph, Tucker and Grant counties.

58. **Tomicus calligraphus,** Germ.

BARK BEETLE.

Mining under green bark on stumps, logs, injured and dying trees. Hastens death of trees and may cause their death. Infests all of the Pines.

Enemies 105, 132? 136? 143? 151.

Adults May 3, 5, 8, 15; June 23, 24; July 13, 27; October 2, 15, 19, 22; November 6. Pupæ June 23; July 13; October 19. Larvæ June 23; July 13. November 6. Eggs May 3, 8; August 10. Adults mining in outer sap-wood October 15.
Wood, Hampshire, Pocahontas, Pendleton, Monongalia, Hardy and Wirt counties.

59. **Tomicus cacographus,** Lec.

BARK BEETLE.

Mining under green bark of logs, stumps, injured and dying trees. Hastens death of injured trees. May cause the death of trees. Infests all the Pines, Black Spruce, Norway Spruce.

Enemies 88, 89, 105, 131?, 132? 135?, 144?, 149, 151, 155, 161.

Adults April 1; May 3, 8, 9, 15, 18, 20, 23; June 13, 14, 23, 24, 29; July 9, 13, 14, 24. 28; August 12, 29. Pupæ June 13, 14, 23, 24, 29; August 29; November 7. Larvæ May 18; June 13, 23, 24; July 28; November 7. Eggs May 3, 8, 9; July 13, 20, 28. Adults emerging from bark July 14; November 7. Mining in outer sap-wood August 12.
Wood, Hardy, Marion, Monongalia, Grant, Hampshire, Pendleton and Randolph counties.

60. Tomicus pini, Say.

BARK BEETLE.

Mining under green bark of logs, stumps, injured and dying trees. Hastens death of trees. Infests all of the pines. Norway Spruce.

Enemies 105, 121 ?, 125 ?, 159, 161.

Adults May 3, 4, 30; July 14, 20, 27; November 7. Pupæ July 20, 27. Larvæ May 3, 30; November 7. Eggs May 3.

Hardy, Wetzel, Marshall, Pocahontas, Hampshire, Pendleton and Monongalia counties.

61. Tomicus avulsus, Eich.

BARK BEETLE.

Mines under green bark and in outer sap-wood of logs, stumps and dying trees. Hastens death of trees. Infests White and other Pines.

Enemy 156.

Adults May 4, 6, 8; June 23. Eggs May 8.

Wood, Hampshire and Pendleton counties.

62. Tomicus cælatus, Eich.
(*Xyleborus cælatus, Eich.*)

BARK BEETLE

Mines under green bark on logs, stumps, living and dying trees. Hastens death of trees. Infests all of the pines, Black, Spruce, Norway Spruce.

Enemies 107, 121 ?.

Adults March 15; April 30; May 3, 11; June 4, 12; July 1, 4, 13, 20, 21, 27; September 1, 30; October 11, 17, November 13. Pupæ July 13, 21. Larvæ May 18; July 13, 21. Eggs April 30; May 1.

Adults emerged July 1. Eggs June 12; July 21.

Monongalia, Wirt, Wood, Wetzel, Marshall, Hampshire, Randolph counties.

63. **Tomicus plagiatus**. Lec. Equals 11a this list.

64. Scolytus quadri spinosis, Say.

HICKORY BARK BEETLE.

Mining under green bark on logs, stumps and dying trees. Infests Hickory.

Enemies 85, 92, 158.

Adults July 22; August 10. Pupæ April 29, 30. Larvæ July 22, 24, 29, 30; August 10; November 7. Eggs July 24; August 10.

Tyler, Wood and Monongalia counties.

65. Scolytus muticus, Say.

HACKBERRY BARK BEETLE.

Mines in bark and wood of felled and dead trees, dead branches on living trees. Hastens decay of wood. May hasten death of idjured trees. Infests Hackberry.

Enemies 91?, 95?.

Adults emerged May 2. Larvæ full grown October 23; February 28.

Wood and Monongalia counties.

66. Scolytus rugulosus, Ratz.

EUROPEAN FRUIT BARK BEETLE.

Mines under green bark of injured dying and living trees, cut and broken branches. Hastens death of trees. May be the primary cause of death of trees. Infests Apple, Cultivated Cherry, Plum, Peach, Pear and Quince.

Enemies 81, 97, 98, 99, 100, 108, 110, 142, 146?, 153, 155, 157a, 158, 166?.

Adults April 15, 17, 29; May 8, 19; June 16, 17, 20, 21, 22, 24, 25, 26, 29; July 1, 20, 24, 25, 26, 30, 31; August 12, 13, 29; September 7. Pupæ January 1, 17; April 17; June 1; July 20; August 22. Larvæ January 1, 17; April 17; June 1, 20, 22, 25; July 20; August 22; October 23; December 24. Eggs June 16, 17, 21, 22, 25; July 26; August 29; September 27. Observed adults emerging June 1, 22; July 26; August 22. Observed adults copulating September 7; October 5.

Monongalia, Wood, Cabell, Tyler, Harrison, Marshall counties.

67. Chramesus icoriæ, Lec.

BARK BEETLE.

Mining under partly green bark on cut branches and tops of dying trees. Infests Hickory.

Enemies 147?, 161.

Adults April 23, 29; June 24, 25; October 15.

Wood and Marion counties.

68. **Polygraphus rufipennis,** Kirby.

SPRUCE BARK BEETLE.

Mining under green bark on logs, tops, stumps, broken branchss, living, injured and dying trees. Causes death of trees. A destructive species. Infests Black Spruce. Enemies 84, 93, 96, 103, 104, 112, 113. 115?, 121?, 122?, 123?, 133?, 134?, 137?, 150, 151. 155, 157, 161, 162, 164

Adults March 26, 28, 31; May 8, 9, 12, 30; June 4, 21, 22, 23; July 7, 8, 11, 12; August 12, 29, 30; September 1, 2, 14; October 22, 28; November 31 Pupæ May 30. Larvæ March 26, 29, 31; June 23; July 9, 12; September 1. Eggs May 9; June 23; July 8, 9. Adults developed from eggs between May 12 and July 22.

Randolph, Grant, Tucker, Pendleton and Monongalia counties.

69. **Phlœotribus liminaris,** Harr.

BARK BEETLE.

Mining under green bark on living, injured and dying trees, broken branches, logs, stumps, etc. Hastens death of trees. May prove a troublesome pest. Infests peach, cultivated cherry, wild cherry. Adults hibernate in outer bark of living trees. Enemy 157*a*.

Adults April 3, 17; May 11, 15, 30; July 13, 20, 24; November 26; February 7. Pupæ July 13, 21 Larvæ July 13, 24. Eggs May 30; July 13.

Wood, Marshall and Monongalia counties

70. **Phlœotribus sp. a.**

BARK BEETLE?

Adult flying May 18.
Wood county.

71. **Phlœotribus, sp. b.**

BARK BEETLE.

Under bark on dead trees. Infests Red Cedar.

Adult October 22.
Marion county.

72. Phlœotribus, frontalis, Oliv.

BARK BEETLE.

Mining under green bark on living, injured and dying trees, and broken branches. Hastens death of trees. Infests Mulberry.

Adults hibernate in outer bark on living trees.

Enemy 145?.

Adults April 9, 23; June 24; July 20, 29; December 4. Pupæ June 21; December 4. Larvæ June 24; December 4.

Wayne, Wetzel and Monongalia counties.

73. Hylesinus aculeatus, Say.

ASH BARK BEETLE.

Mining under green bark of logs, stumps and dying trees. Hastens death of trees. Infests Ash (black).

Adults June 20; July 24; August 10. Pupæ June 20; July 24. Larvæ June 20; July 24; August 10. Eggs June 20.

Monongalia, Randolph and Tucker counties.

74. Hylesinus opaculus, Lec.

ELM BARK BEETLE.

Mining under green bark on logs, stumps, dying trees and broken branches. Hastens death of trees. Infests Elm.

Enemy 151.

Adults July 6, 21; August 4, 10 Pupæ July 21. Larvæ July 21; August 4.

Wetzel, Hancock and Kanawha counties.

75. Phlœosinus dentatus, Say.

CEDAR BARK BEETLE.

Mining under green bark on logs, stumps, tops of injured and dying trees and broken branches. Hastens death of trees. Beneficial in separating bark from posts, thus preventing decay of sap-wood. Infests Red Cedar.

Enemies 88, 102, 109, 148, 149.

Adults April 29; May 1, 8, 20, 23; June 1, 9, 14, 18, 24, 25; July 4; August 1, 5; October 8; November 8. Pupæ June 1, 18; August 5, 8. Larvæ May 23; June 1; November 8; August 5. Eggs April 29; May 4, 8. Bred: first eggs May 8. Larvæ full grown June 1. Adults emerged June 9. Second brood eggs July 15 to 18. Pupæ August 5.

Wood, Grant, Monongalia and Hampshire counties.

76. Dendroctonus terebrans, Oliv.

BARK BEETLE.

Mining in green bark and turpentine on living and dying trees, logs, and stumps. Hastens death of trees. May be primary cause of death of trees. Infests all of the pines.

Adults May 3, 4, 5; June 23; July 13, 21; August 10; September 23; October 10, 14; November 8. Pupæ July 13, September 28. Larvæ June 23; July 13, 21; August 10; October 14. Eggs May 3, 4. Bred: Larvæ July 13. Adult emerged September 28.

Hampshire, Monongalia. Pendleton, Hardy, Marion and Wood counties.

77. Dendroctonus frontalis, Zimm.

THE DESTRUCTIVE PINE BARK BEETLE.

Mining under green, sappy bark on living, healthy trees. Primary cause, within four years of the death of over $1,000,000 worth of timber. Very destructive. Infests all of the pines. Black Spruce, Norway Spruce. Enemies 82, 106, 111, 121?, 151, 156, 161, 168.

Adults May 3, 4, 5, 18, 22; June 23, 24; July 11, 13, 17, 24; August 10; September 12, 29; October 10, 12, 21; November 7; December 1. Pupæ May 3, 4, 5; August 10; October 10, 21; Larvæ May 3, 4, 5, 30; July 12; August 10; October 10, 21. Eggs May 5, 20; July 24; November 7. Breeding dates: adults entered green bark May 18; young larvæ found May 30. Pupæ July 24. Larvæ collected November 7. Adults emerged December 1.

Hampshire, Hardy, Tucker, Randolph, Pendleton, Monongalia, Wood and Greenbrier counties.

78. Crypturgus pusillus, Gyll.
(*Crypturgus atomus, Lec.*)

BARK BEETLE.

Mining in bark on dying and dead trees. May hasten death of trees. Infests the pines, Black Spruce. Enemy 161.

Adults March 20, 26, 28; June 24; July 9, 13; August 30; October 1. Larvæ March 26, 28.

Wood, Tucker, Randolph, Grant Hampshire and Monongalia counties.

79. Hylastes, sp.

BARK BEETLE

In bark of dying pines

Adult May 3.
Hardy county.

80. **Hylurgops glabratus**, Zett.
(*Hylurgops pinifex*, Fitch.)

BARK BEETLE.

Mining under green bark at base of dying trees. Also on logs and stumps. Hastens death of trees. Infests the pines.

Adults May 3, 4, 5; June 29. Pupæ October 4. Eggs May 3, 4, 5. Bred: adults entered bark May 18, young larvæ June 13. Full grown larvæ July 14.

Wood, Hampshire, Pendleton, Grant and Monongalia counties.

ENEMIES OF SCOLYTIDÆ

Including Predaceous, Parasitic, and other Species

Found with Members of this Family.

Collected and bred March 1890 to March 1893.

Order HYMENOPTERA; Family ICHNEUMONIDÆ.

81. **Hemiteles scolyti**, Ashm., sp. n., MS.

With *Scolytus rugulosus* (66) In dead peach twigs.

Adults bred April 20.
Wood county.

ORDER HYMENOPTERA; FAMILY BRACONIDÆ.

82. **Bracon pirsodis**, Ashm.

PRIMARY PARASITE.

Attacks *Dendroctonus frontalis* (77) in pine bark.

Adults bred January 29. Cocoons November 7.
Monongalia county.

83. **Rhyssalus pityophthori**, Ashm., sp. n.

With *Pityophthorus sp d* (20.) In pine bark.

Adults bred July 29.
Described by William H. Ashmead, "Canadian Entomologist," XXV., page 69.
Wood county.

84. **Spathius claripennis**, Ashm., sp. n.

PRIMARY PARASITE.

Attacks *Polygraphus rufipennis* (68) in Spruce bark.

Adults bred April 20. Cocoons March 26; Sep. 26; Nov. 31; Larvæ May 4.

Described by Wm. H. Ashmead, "Canadian Entomologist," XXV., page 72.

Tucker and Monongalia counties.

85. **Spathius unifasciatus**, Ash. n. sp.

PRIMARY PARASITE.

Attacks *Scolytus 4-spinosus* (64), Hickory Bark.

Adults bred April 29.

Described by Wm. H. Ashmead "Canadian Entomologist," XXV., page 72.

Wood county.

86. **Spathius brachyurus**, Ash. n. sp.
(87.)

PRIMARY PARASITE.

Attacks *Dryocoetes autographus* (54) in Spruce bark.

Adults bred April 6; Nov. 10. Cocoons March 15; April 6.

Described by Wm. H. Ashmead "Canadian Entomologist," Vol. XXV., page 73.

Monongalia county.

88. **Spathius Canadensis**, Ash. n. sp.

PRIMARY PARASITE.

With *Phloeosinus dentatus* (75) Red Cedar and *Tomicus cacographus* (59) in White Pine.

Adults bred May 2, 10. Cocoons March 31; April 14, 18, 23.

Wood county.

89. **Spathius pollidus**, Ash n. sp.

PRIMARY PARASITE.

Attacks *Tomicus cacographus* (59) in Pine Bark.

Adult bred June 23.

Described by Wm. H Ashmead in "Canadian Entomologist," Volume XXV., Page 74.

Wood county.

90. **Spathius tomici**, Ash. n. sp.

PRIMARY PARASITE.

Attacks *Dryocoetes autographus* (54) in Spruce bark.

Adults bred April 6; Cocoons March 15.

Monongalia county.

91. **Spathius brunneus**, Ashm.

With *Scolytus muticus* (65) in Hackberry bark.

Adults bred. Cocoons May 2.
Kanawha county.

92. **Lysitermus scolyticida**, Ash. n. sp.

PRIMARY PARASITE.

Attacks *Scolytus 4-spinosus* (64) in Hickory bark.

Adults bred from Cocoons, April 30.
Wood county.

93. **Lysitermus sp?**

PRIMARY PARASITE.

Attacks *Tomicus plagiatus* (11*a.* 63) in Pine bark.

Adults bred. Cocoons, October 14.
Monongalia county.

94. **Cænophanes pityophthori**, Ash, n. sp.

PRIMARY PARASITE.

Attacks Pityophthorus sp. c, (17) *Polygraphus rufipennis* (68) in Spruce bark.

Adult flying May 2. Cocoons February 24. (Adults bred.) Larvæ October 25. Described by Wm. H. Ashmead, "Canadian Entomologist" XXV. Page 78.
Monongalia and Wood counties.

95. **Helcon legator**, Say.

PRIMARY PARASITE.

With *Scolytus muticus* (65) in Hackberry.

Adults bred. Cocoons, May 2.
Wood county.

96. **Cosmophorus, hopkinsii** n. sp., Ash. MS.

PRIMARY PARASITE.

Attacks *Polygraphus rufipennis* (68) Larvæ in Spruce bark.

Adults flying August 29. Adults bred September 14; Oct. 25.
Randolph county.

ORDER HYMENOPTERA; FAMILY CHALCIDIDÆ.

97. **Eurytoma bicolor**, Walsh.

PRIMARY PARASITE.

Attacks *Scolytus rugulosus* (66) in Apple bark.

Adults August 8.
Monongalia county.

98. **Eurytoma sp. a.**

PRIMARY PARASITE.
With *Scolytus rugulosus* (66) in Apple bark.

Adult Aug. 19.
Monongalia county.

99. **Eurytoma sp. b.**

PRIMARY PARASITE.
With *Scolytus rugulosus* (66) in Apple bark.

Adult Aug. 12.
Wood county.

100. **Eurytoma sp. c.**

PRIMARY PARASITE.
Attacks *Scolytus rugulosus* (66) in Apple, Peach, Cherry and Plum bark

Adults March 4, 25; April 17, 25; June 18, 22; July 25; Aug. 12.
Wood county.

101. **Eurytoma sp d.**

PRIMARY PARASITE?
Attacks *Tomicus plagiatus* (11*a*. 63) in Pine bark.

Adult bred Oct. 14.
Monongalia county.

102. **Eurytoma sp. e.**

PRIMARY PARASITE.
Attacks *Phloeosinus dentatus* (75) in Cedar bark.

Adults bred May 4; July 24. Larvæ April 14. Adult emerged May 4.
Wood county.

103 **Eurytoma, sp f.**

PRIMARY PARASITE.
Attacks *Polygraphus rufipennis* (68) Larvæ in Black Spruce.

Adult Sept. 26.
Randolph county.

104. **Lochites sp. a.**

PRIMARY PARASITE.
Attacks *Polygraphus rufipennis* (68) in Spruce bark.

Adults March 31; April 14; May 9; July 13; Sept. 1. Pupæ April 2. Larvæ March 26, 28.
Randolph, Grant, Tucker and Monongalia counties.

105 **Lochites sp. b.**

PRIMARY PARASITE.

Attacks *Tomicus cacographus* (59) *Tomicus calligraphus* (58) *Tomicus pini* (60). in pine bark.

Adults July 20. Aug. 12, 22.
Wood and Marshall counties.

106. **Lochites sp. d.**

PRIMARY PARASITE

Attacks *Dendroctonus frontalis* (77) in Pine bark.

Adults bred January; Larvæ December; October 10.
Monongalia county.

107. **Lochites, sp. e.**

PRIMARY PARASITE.

Attacks *Tomicus caelatus* (62 in Norway Spruce bark.

Adults July 13.
Monongalia county.

108. **Chiropachys color**, Linn

PRIMARY PARASITE.

Attacks *Scolytus rugulosus* (66) in Apple, Peach, Plum and Cherry bark.

Adult March 17, 21; April 15; May ; June 18, 22, 26; July 20, 22, 25; August 8, 12; November 8; January 17. Larvæ January 17.
Wood, Monongalia and Marshall counties.

109. **Pteromalus sp. b.**

PRIMARY PARASITE.

Attacks *Phloeosinus dentatus* (75) in Cedar bark.

Adult April 18.
Wood county.

110. **Platygerrhus sp.**

PRIMARY PARASITE.

Attacks *Scolytus rugulosus* (66) in Apple bark.

Adults April 29.
Wood county.

111. **Heydenia unica**, Cook.

PRIMARY PARASITE.

Attacks *Dendroctonus frontalis* (77) in Pine bark.

Adults January . Larvæ November 7.
Monongalia county.

112. **Spintherus sp**

PRIMARY PARASITE.

Attacks *Polygraphus rufipennis* (68) in Spruce bark.

Cocoons September 1. Adults bred.
Randolph county.

113. **Trigonoderus** sp.

PRIMARY PARASITE.

Attacks *Polygraphus rufipennis* (68) in Spruce bark.

Adults April 14; June 23; July 10, 12; Sept. 1. Larvæ March 26. Randolph county.

114. **Chalcid.**
Belongs to sub-family Pteromalinæ.
Ashmead (in letter).

Bred from adult *Pityophthorus minutissimus* (8).

Adults emerged March 10.
Monongalia county.
In a letter dated March 16th, Mr. Wm. H. Ashmead says this is the first observation of the kind made in the family *Chalcididæ*.

115. **Decatoma** sp.

With *Polygraphus rufipennis* (68) in Spruce bark.

Adults July 12.
Grant county.

Order HYMENOPTERA; Family PROCTOTRYPIDÆ

116. **Aphalonomia hyalinipennis**, Ash.

With *Hypothenemus, sp. b.* (28) in White Walnut twigs.

Adults April 24.
Monongalia county.

Order HYMENOPTERA Family CHALCIDIDÆ.

(*Secondary Parasite.*)

117. **Tetrostrichus, sp. a.**

SECONDARY PARASITS?

Bred from *Thanasimus* larvæ in Sumach, and *Thanasimus dubius* (151) larvæ in Spruce bark.

Adults June. Larvæ March 29.
Tucker county.

118. **Tetrastrichus sp. b.**

SECONDARY PARASITE?

With *Scolytus rugulosus* and *Chalcid* parasites of S. rugulosus, in Apple bark.

Aduts April 25. June 23, 26.
Wood county.

Order DIPTERA; Family MUSCIDÆ.

119. **Tachina sp.**

Bred from adult *Thanasimus dubius* (151.)

Larva emerged from beetle August 12, changed to pupa August 13.
Adult emerged August 28.
Monongalia county.

Predaceous Enemies, etc.

Order COLEOPTERA; Family STAPHYLINIDÆ.

120. **Quedius peregrinus.** Grav.

PREDACEOUS?

With *Scolytids* under Spruce bark.

Adult August 29.
Randolph county.

121. **Homalota sp.**

PREDACEOUS.

With *Tomicus cælatus* (62). *Tomicus pini* (60) *Polygraphus rufipennis* (68) in Spruce and *Dendroctonus frontalis* (77) in Pine bark.

Adults September 1, 22, 25; October 21, 22; April 17, 14; May 4, 30; July 13.
Randolph, Monongalia, Tucker, Wood and Pendleton counties.

122. **Xantholinus cephalus,** Say.

PREDACEOUS?

On bark of Black Spruce tree infested with *Polygraphus rufipennis*: (68.)

Adults march 29.
Tucker county.

123. **Baptolinus longiceps,** Fab.

PREDACEOUS.

With *Polygraphus rufipennis* (68) in Spruce bark.

Adult September 1, March 28.
Randolph and Tucker counties.

124. **Siagonum americanum,** Melsh.

PREDACEOUS.

With *Dryocœtes autographus* (54) in Spruce bark, and *Dryocœtes n. sp.*, (55) in Birch bark.

Adults May 8; July 11. Larvæ May 8.
Tucker and Grant counties.

125. **Staphylinid larvæ.**

PREDACEOUS LARVAE.

With *Tomicus pini* (60) in Pine bark.

Larvæ July 20.
Wetzel county.

Order COLEOPTERA; Family ENDOMYCHIDÆ.

126. **Endomychus biguttatus,** Say.

With Scolytids under Pine bark.

Adults October 15; December 6.
Marion and Monongalia counties.

Order COLEOPTERA; Family COLYDIDÆ.

127. **Aulonium tuberculatum,** Lec.

With Scolytids in Pine bark.

Adults July 13.
Hampshire county.

128. **Colydium lineola,** Say.

PREDACEOUS.

With *Platypus quadridentatus*, (1) in sap wood of Black Oak. *Xyloterus politus* (39) in Red Maple. *Monarthrum mali* (5) in Jack Oak, and in Scolytid mines in Pine bark.

Adults July 13, 29, 30; August 19, 27; September 12.
Hampshire, Wayne, Tyler, Monongalia and Wood counties.

129. **Sosylus costatus**, Lec.

PREDACEOUS.

With *Platypus quadridentatus* (1) in Black Oak.

Adult July 29.
Wayne county.

130. **Philothermus glabriculus**, Lec.

With Scolytids under Spruce bark.
Under dead Locust bark.

Adults August 29; October 11.
Randolph and Monongalia counties.

Order COLEOPTERA; Family HISTERIDÆ

131. **Hister parallelus**, Say.

With *Drycœtes autographus* (54) in Spruce; *Tomicus cacographus* (59) and *Gnathotrichus materiarius* (7) in Pine.

Adults May 18; June 24, 29; July 20; November.
Monongalia, Wood and Marshall counties.

132. **Hister cylindricus**, Payk.

With *Tomicus cacographus* (59) and *Tomicus calligraphus* (58) in Pine bark

Adults May 5, 8; August 12.
Wood and Pendleton counties.

133. **Paromalus bistriatus**, Er.

With *Polygraphus rufipennis* (68) in Spruce bark.

Adults July 11; August 30.
Randolph and Tucker counties.

134. **Paromalus difficilis**, Horn.

With *Polygraphus rufipennis* (68) and *Dryocœtes affaber* (56) in Spruce bark.

Adults July 8, August 28; September 1. Pupæ July 8.
Randolph county.

135. **Plegaderus transversus**, Say.

With *Tomicus cacographus* (59) in Pine bark.

Adults June 24, 29; July 20.
Wood and Marshall counties.

Order COLEOPTERA; Family NITIDULIDÆ.

136. **Colastus unicolor**, Say.

With *Pityophthorus confinis* (14) and *Tomicus calligraphus* (58). Under bark on dead Pine.

Adults May 4.
Pendleton county.

137. **Epuræa truncatella**, Mann.

With *Polygraphus rufipennis* (68) in Spruce bark.

Adults March 26; July.
Tucker and Grant counties.

138. **Ips fasciatus**, Oliv.

With *Xyloterus bivittatus* (37) on Spruce logs.

Adults May 8.
Grant county.

139. **Nitidulidæ larvæ**
Ips faciatus?

With *Xyloterus bivittatus* (37) in Spruce wood. *Platipus compositus* (2) in Basswood, and *Cyllene Robiniæ* larvae in locust bark on living tree.

Larvæ May 14; June 1; July 9, 21.
Wood and Grant counties.

140. **Ips sanguinolentus**, Oliv.

PREDACEOUS.

With *Xyloterus politus* (39.) Under Sugar Maple bark, also feeding on Black Walnut sap.

Adults April 5; May 9.
Wood and Grant counties.

141. **Rhizophagus dimidiatus**, Mann.

With Scolytids under Spruce bark.

Adults March 26; September 1.
Randolph and Tucker counties.

142. **Rhizophagus bipunctatus**, say.

With *Scolytus rugulosus* (66) in Apple bark. *Monarthrum fasciatum* (4) in Beech bark and *Dryocœtes n. sp.* (55) in Birch bark.

Adults March 21; April 18; May.
Wood, Pendleton and Monongalia counties.

Order COLEOPTERA; Family LATHRIDIIDÆ.

143. **Corticaria elongata**, Hum.

With *Tomicus calligraphus* (58) under bark on Pine.

Adults July 27.
Wirt county.

Order COLEOPTERA; Family TROGOSITIDÆ.

144. **Nemosoma cylindricum**, Lec.

With *Tomicus cacographus* (59) in Pine Bark.

Adults May 20.
Wood county.

145. **Tenebrioides corticalis**, Melsh.

Under bark on dead Apple tree and with *Phlœotribus frontalis* (72) in bark of live Mulberry.

Adults September 7. Pupæ April 25. Adult emerged May 12.
Monongalia and Wood counties.

Order COLEOPTERA; Family MALACHIDÆ

146. **Attalus scincetus**, Say.

With *Scolytus rugulosus* (66) in apple bark.

Adult March 21.
Monongalia county.

Order COLEOPTERA; Family CLERIDÆ.

147. **Elasmocerus terminatus**, Say.

PREDACEOUS.

With *Chramesus icoriæ* in Hickory.

Adult flying June 22. Adults bred from Hickory April 23.
Wood and Monongalia counties.

148. **Cymatodera bicolor**, Say.

PREDACEOUS.

With *Phloeosinus dentatus?* (75). in Cedar bark.

Adult May 15.
Wood county.

149. **Clerus quadrisignatus**, Oliv.
var **nigripes**, Say.

PREDACEOUS.

With *Tomicus cacographus* (59) and *Pityophthorus pullus* (10) in Pine bark; with *Phloeosinus dentatus* (75) in Red Cedar.

Adult April 29; May 4, 9.
Grant county.

150. Thanasimus trifasciatus, Say

PREDACEOUS.

With *Polygraphus rufipennis* (68) under Spruce bark

Adult March 28; August 29; Larvæ March 28.
Randolph and Tucker counties.

151. Thanasimus dubius, Fab.

PREDACEOUS.

Attacks *Tomicus cacographus* (59), *Tomicus calligraphus* (58), *Dendroctonus frontalis* (77), *Pityophthorus pullus* (10), *P. puberulus* (19), *P.tyophthorus sp. d.* (20), in Pine bark. *Polygraphus rufipennis* (68), in Spruce bark, and *Hylesinus opaculus* (74) in Elm bark.
Enemy? 117. Enemy 119.

Adults May 2, 8, 30; August; September 1; October 6; November; Larvæ March 28, 31; May 3; July 21, 30; August 29; September 7; October 6, 10, 21.
Randolph, Tucker, Hampshire, Monongalia, Grant and Wood Counties.

152. Clerus formicarius, L.
=? *Thanasimus formicarius*, L.

THE EUROPEAN BARK BEETLE DESTROYER.

Destructive to Scolytids in European Coniferous forests. One thousand live specimens of adults, larvæ and pupæ, imported to America in October, 1892, by the West Virginia Experiment Station, aided by owners of pine forests. First adults collected by me in Government forest of Pinus. Sylvestris near Hagenau, Alsace, Germany, August, 29, 1892. First adults set free in American pine forest near Morgantown, W. Va. On October, 10, 1892. This species was introduced to prey upon *Dendroctonus frontalis* and other species of Scolytidæ.

153. Thanasimus sp. d.

PREDACEOUS.

With *Scolytus rugulosus* (66) on Apple tree.

Adult June 17.
Upshur county.

154 Thaneroclerus sanguineus, Say.

PREDACEOUS.

On Hemlock Stump with *Xyloterus bivittatus* (37)

Adult May 8.
Grant county.

155. Phyllobænus dislocatus, Say.

PREDACEOUS.

Attacks *Polygraphus rufipennis* (68) in Black Spruce, and *Pityophthorous consimilis* (15) in Sumach (*Rhus glabra.*) With *Scolytus rugulosus* (66) in Apple bark.

Adults bred June 16, 20, 22; Dec. 7.
Randolph, Wood and Monongalia counties

156 Clerid larvæ sp a.

PREDACEOUS.

With *Dedroctonus frontalis* (77) *Tomicus avulsus* (61) and *Tomicus cacographus* (59) larvæ in Pine bark.

Larvæ June 23, 29; Oct. 14.
Wood county.

157. Clerid larvæ sp. b.

PREDACEOUS.

With *Polygraphus rufipennis* (68) larvæ in Spruce.

Larvæ July 23; March 26.
Tucker and Wetzel counties.

157*a*. Clerid larvæ sp. c.

PREDACEOUS

With *Phloeotribus liminaris* (69) in Wild Cherry, and *Scolytus rugulosus* (66) in Apple bark.

Larvæ March 2; July 13.
Monongalia county.

158. Clerid Larvæ sp. d.

PREDACEOUS.

With *Scolytus rugulosus* (66) in Apple bark, *Scolytus quadrispinosus* (64) in Hickory bark and *Scolytus muticus* (65) in Hackberry bark.

Larvæ March 2; July 20; October 7; November 23.
Marshall and Monongalia counties.

159. Clerid larvæ sp e.

PREDACEOUS

Tomicus pini (60) in pine bark.

Larvæ July 20.
Marshall county.

Order CLEOPATRA: Family TENEBRIONIDÆ.

160. **Hypophloeus Cavus**, Lec.

PREDACEOUS.

With *Xyleborus celsus* (44) in Hickory.

Adult July 22.
Tyler county.

161. **Hypophloeus parallelus**. Melsh.

PREDACEOUS.

With *Polygraphus rufipennis* (68) in Spruce bark, *Tomicus cacographus* (59) *Tomicus pini* (60) *Dendroctonus frontalis* (77) *Crypturgus pussillus* (78) in Pine bark, and *Chramesus icoriæ* (67) in Hickory bark.

Adults March 26; May 5, 18; June 24, 25, 29; July, 8, 13, 14, 20, 24; August; November 7. Larvæ August 12; October 12. Grant, Hampshire, Wood, Hardy, Monongalia, Pendleton, Randolph, Marshall and Tucker counties.

162. **Hypophloeus thorracicus**. Melsh.

PREDACEOUS.

With *Polygraphus rufipennis* (68) in Spruce bark.

Adult August 29.
Randolph county.

163. **Hypophloeus bicolor**, Melsh.

PREDACEOUS.

With *Xyleborus pubescens* (51) in Chestnut wood, *Xyleborus fuscati* (45) in Black Oak wood.

Adults May 20; July 30.
Wood county.

164. Tenebrionid larvæ.

PREDACEOUS.

With *Polygraphus rufipennis* (68) in Spruce bark.

Larva Aug. 30.
Randolph county.

165. Hypophloeus sp. a.

PREDACEOUS.

With *Xyleborus sp. b.* (46) in Chestnut Oak wood.

Adult July 30.
Wood county.

166. Anthicus pubescens, Lec.

With *Scolytus rugulosus* (66) in Plum bark.

Adults April 25.
Wood county.

FUNGACEÆ.

168. Cylindrocola dendroctoni, Pk. (n. sp.) **Fungus Disease.**

On and with dead adults, larvæ, and pupæ of *Dendroctonus frontalis* under Pine bark. The fungus probably kills the insect Peck.

Collected, May 3, 4, 5.
Hampshire. Hardy and Pendleton Counties.
Species described in Flora, of W. Va., (Bulletin 24), page 51

TREES AND SHRUBS INFESTED BY SCOLYTIDÆ.

MAGNOLACEÆ.

Plants.	*Insects.*	
Cucumber Tree,	Platypus compositus, Say,	2
Magnolia acuminata, L.	Xyloterus politus, Say.	39
	Xyleborus pubescens, Zimm.	51
Tulip Tree, "Yellow Poplar."		
Liriodendron tulipifera, L.	Monarthrum mali, Fitch,	5

TILIACEÆ.

Plants.	*Insects.*	
Basswood,		
Tilia Americana, L	Platypus compositus, Say,	2
	Monarthrum fasciatum, Say,	4
	Monarthrum mali, Fitch	5
	Xyleborus pubescens, Zimn.	51

SAPINDACEÆ.

Plants.	*Insects.*	
Buckeye		
Aesculus octandra, Marsh.	Monarthrum mali, Fitch,	5
(*Aesculus flava*, Ait.)	Xyleborus pubescens, Zimn.	51
Sugar Maple,		
Acer saccharum, Marsh.	Platypus compositus, Say.	2
(*Acer saccharinum*, Wang.)	Xyloterus politus, Say,	39
Red Maple,		
Acer rubrum, L.	Monarthrum mali, Fitch,	5
	?Pityophthorus sp. b.,	11
	Xylotus politus, Say,	39

ANACARDIACEÆ.

Stag-horn Sumach, *Rhus typhina*, L	Pityophthorus consimilis, Lec.,	15
Smooth Sumach, *Rhus glabra*, L	Pityophthorus consimilis, Lec.,	15
Dwarf Sumach, *Rhus copallina*, L.	Pityophthorus consimilis. Lec.,	15
Poison Ivy, *Rhus Toxicodendron* L	Pityophthorus consimilis, Lec.	15
Poison Sumach, Poison Elder, *Rhus venenata*, L	Pityophthorus consimilis, Lec.	15
Fragrant Sumach, *Rhus Canadensis*, Marsh	Pityophthorus consimilis, Lec.	15

LEGUMINOSÆ.

Honey Locust, *Gleditschia triacanthos*, L.	Monarthrum mali, Fitch.	5
	Xyleborus pubescens, Zimm.	51

ROSACEÆ.

Apple. *Pyrus malus*, L.	Pityopthorus sp. h.	25
	Hypothenemus sp. a.	27
	Hypothenemus sp. c.	29
	Xyleborus xylographus, Say.	49
	Scolytus rugulosus, Ratz.	66
Pear, *Pyrus communis*, L.	Scolytus rugulosus, Ratz.	66
Peach, *Persica vulgaris*, Dec.	Scolytus rugulosus, Ratz.	66
	Phloeotribus liminaris, Harr.	69
Quince, *Cydonia vulgaris*, Dec.	Scolytus rugulosus, Ratz	66
Plum, *Prunus domestica*, L.	Scolytus regulosus, Ratz.	66
Cultivated Cherrry, *Prunus vulgaris*, L.	Monarthrum mali, Fitch,	5
	Xyleborus pubescens, Zim.	51
	Scolytus rugulosus, Ratz.	66
	Phloeotribus liminaris, Harr.	69
Wild Black Cherry, *Prunus serotina*, Ehrh.	Platypus compositus, Say.	2
	Dryocoetes n. sp.	55
	Scolytus rugulosus, Ratz.	66
	Phloeotribus liminaris, Harr.	69

CORNACEÆ.

Flowering Dogwood, *Cornus florida*, L.	Pityophthorus minutissimus, Zim.	8

OLEACEÆ.

Black Ash,		
Fraxinus sambucifolia, Lam.	Xyleterus politus, say.	39
	Hylesinus aculeatus, Say.	73

LAURACEÆ

Sassafras,		
Sassafras, officinale, Nees.	Corthylus punctatissimus, Zimm.	3

URTICACEÆ

Slippery, or Red Elm,		
Ulmus fulva, Michx.	Platypus compositus, Say.	2
White Elm,		
Ulmus Americana, L.	Hylesinus opaculus, Lec.	74
	Xyloterus politus, Say.	39
	Monarthrum mali, Fitch.	5
Hackberry, "Hoop Ash,"		
Celtis occidentalis, L.	Scolytus muticus, Say.	65
Black, or Red Mulberry,		
Morus rubra, L.	Phlœotribus frontalis, Oliv.	72

JUGLANDACEÆ

White Walnut, Butternut,		
Juglans cinerea, L.	Hypothenemus sp. b.	28
Black Walnut,		
Juglans nigra, L.	Hypothenemus sp. b.	28
Hickory,		
Hicoria, Raf.		
Carya, Nutt.	Xyloterus politus, Say	39
	Xyleborus celsus, Eich	44
	Xyleborus fuscatus, Eich.	45
	Xyleborus sp. d.	48
	Hypothenemus dissimils, Zimm.	32
	Hypothenemus sp. e.	33
	Scolytus quadrispinosus, Say.	64
	Chramesus icoriæ, Lec.	67

CUPILIFERÆ

Sweet, or Black Birch,		
Betula lenta, L.	Xyleborus pyri, Peck	41
	Dryocœtes n. sp.	55
	Xyloterus politus, Say.	39
White Birch,		
Betula populifolia, Ait.	Xyloterus politus, Say	39
	Xyleborus pyri, Peck	41
	Dryocœtes n. sp.	55

White Oak, *Quercus alba*, L.	Monarthrum fasciatum, Say,	4
	Monarthrum mali, Fitch,	5
	Pityophthorus minutissimus, Zimm.	8
	Hypothenemus sp. f.	34
	Hypothenemus sp. g.	35
	Xyloterus politus, Say,	39
	Xyleborus sp. b.	46
	Xyleborus pubescens, Zimm.	51
Chestnut Oak, *Quercus prinus*, L.	Pityophthorus minutissimus, Zimm.	8
	Xyleborus sp. b.	46
Red Oak, *Quercus rubra*, L.	Monarthrum mali, Fitch,	5
	Xyloterus politus, Say,	39
	Xyleborus pyri, Peck.	41
Scarlet Oak, *Quercus coccinea* Wang.	Pityophthorus minutissimus, Zimm.	8
Black Oak. *Quercus tinctoria*, Bart.	Platypus quadridentatus, Oliv.	1
	Playtypus compositus, Say,	2
	Monarthrum fasciatum, Say,	4
	Monarthrum mali, Fitch,	5
	Pityophthorus minutissimus, Zimm.	8
	Xyloterus politus, Say,	39
	Xyleborus obesus, Lec.	43
	Xyleborus fuscatus, Eich.	45
	Xyleborus sp. b.	46
	Xyleborus sp. d.	48
	Xyleborus pubescens, Zimm.	51
Jack Oak, *Quercus nigra*, L	Monarthrum mali, Fitch	5
	Pityophthorus minutissimus, Zimm.	8
	Xyleborus sp. b.	46
	Xyleborus sp. c.	47
	Xyleborus pubescens, Zimm.	51
Chestnut, *Castanea sativa*, Mill. var. *Americana*, Sarg.	Platypus quadridentatus, Oliv.	1
	Platypus compositus, Say,	2
	Monarthrum mali, Fitch,	5
	Xyloterus politus, Say,	39
	Xyleborus, sp. d.	48
	Xyleborus pubescens, Zimm.	51

Beech,		
Fagus ferruginea, Ait.	Platypus compositus, Say,	2
	Monarthrum fasciatum, Say,	4
	Monarthrum mali, Fitch,	5
	Xyloterus politus, Say,	39
	Xyleborus pyri, Peck,	41
	Xyleborus obesus, Lec.	43

SALICACEÆ.

Large-toothed Aspen,		
Populus grandidentata, Michx.	Xyloterus retusus, Lec.	36

CONIFERÆ.

Red Cedar.		
Juniperus Virginiana, L.	Monarthrum mali, Fitch,	5
	Phloeotribus sp. b.	71
	Phloeosinus dentatus, Say.	75
	Xyleborus, sp. a.	42
White Pine,		
Pinus strobus, L.	Gnathotrichus retusus, Lec.	6
	Gnathotrichus meteriarius, Fitch,	7
	Pityophthorus sp. a.	9
	Pityophthorus sparsus, Lec.	12
	Pityophthorus sp. d.	24
	Tomicus callographus, Germ.	58
	Tomicus cacographus, Lec.	59
	Tomicus pini, Say,	60
	Tomicus avulsus, Eich.	61
	Tomicus caelatus, Eich.	62
	Dendroctonus terebrans, Oliv.	76
	Dendroctonus frontalis, Zimm.	79
	Crypturgus pusillus, Gyll.	80
	Hylurgops glabratus, Zett.	82
Pines.*		
White Pine.		
Pinus strobus, L.	Monarthrum fasciatum, Say,	4
Loblolly Pine,	Monarthrum mali, Fitch,	5
Pinus Taeda, L,	Gnathotrichus retusus, Lec.,	6
	Gnathotrichus materiarius,	
Pitch Pine,	Fitch,	7
Pinus rigida, Miller.	Pityophthorus, sp. a ,	9
Table Mountain Pine,	Pityophthorus, pullus, Zimn.	10
Pinus pungens, Michx.	Pityophthorus, plagiatus, Lec.,	11*a*
Scrub Pine,	Pityophthorus, sparsus, Lec.,	12
Pinus Virginiana, Miller.	Pityophthorus, confinis, Lec.,	14
(*Pinus inops*, Ait.)	Pityophthorus, lautus, Eich ,	18

*The different pines mentioned are attacked by one or more of the insects named under this head.

Yellow Pine,	Pityophthorus, puberlulus, Lec.	19
Pinus echinata, Miller,	Pityophthorus, sp. d.,	20
(*Pinus mitus*, Michx.)	Pityophthorus, sp. e,	21
	Pityophthorus, sp. f.,	23
	Pityophthorus, sp. g.,	24
	Hypothenemus, sp. d.,	31
	Xyloterus scabricollis, Lec.,	38
	Xyleborus sp. f.,	52
	Tomicus callographus, Germ.	58
	Tomicus cacographus, Lec.,	59
	Tomicus pini, Say	60
	Tomicus avulsus, Eich.,	61
	Tomicus caelatus, Eich.,	62
	Dendroctonus terebrans, Oliv.,	76
	Dendroctonus frontalis, Zimm.	77
	Crypturgus pusillus, Gyll.	78
	Hylastes sp.,	79
	Hylurgops glabratus, Zett,	80
Black Spruce,		
Picea mariana, (Mill.) B. S. P.	Pityophthorus cariniceps, Lec.	13
(*Picea nigra*, Link.)	Pityoyhthorus hirticeps, Lec.	16
(*Abies nigra*, Poir.)	Pityophthorus sp. c.	17
	Pityophthorus tuberculatus, Eich,	22
	Xyloterus bivittatus, Kirby,	37
	Xyloterus polytus, Say,	39
	Dryocoetes autographus, Ratz,	54
	Dryocoetes affaber, Mann.,	56
	Dryocoetes granicollis, Lec.	57
	Tomicus cacographus, Lec.	59
	Tomicus pini, Say,	60
	Tomicus cælatus, Eich.	62
	Polygraphus rufipennis, Kirby,	68
	Dendroctonus frontalis, Zimm.	79
	Crypturgus pusillus, Gyll.	80
Norway Spruce (foreign.)		
Picea excelsa, De candolle.	Dryocoetus autographus, Ratz.	54
	Tomicus cacographus, Lec.	59
	Tomicus pini, Say.	60
	Tomicus cælatus, Eich.	62
	Dendroctonus frontalis, Zimm.	79
	Crypturgus pusillus, Gyll.	80
Hemlock,		
Tsuga Canadensis, Carr.	Monarthrum fasciatum, Say.	4
	Monarthrum mali, Fitch,	5
	Xyloterus bivittatus, Kirby	37
	Xyloterus politus, Say,	39
	Xyleborus pyri, Peck	41
	Xyleborus obesus, Lec.	43

INDEX.

ing the wheat received last fall with what I grew from this seed, I see it improving, or what I have grown is a better quality. Making it short, the Nail Club "will yield more," everything being the same, than any other wheat I have ever grown.

JESSE L. BONAR,
Glen Easton, Marshall County, W. Va.

FAIRMONT, W. VA., NOV. 19, 1889.

MY DEAR SIR:

The eighteen bags sent me last fall were distributed as follows:

In Paw Paw district of this county one bag to J. A Floyd, one to John Straight, one to Z. G. Morgan and two to O. P. Floyd. In Mannington district, one bag to Jacob Myers, one to J. J. Murray, one bag to Fleming Hamilton and one bag to A. Z. Riggs. In Fairmont district, one bag to Charles Conaway, one bag to Thomas Conaway, one bag to B. D. Fleming, one bag to John B. Gray, one bag to M. L. Fleming, one bag to E. Hamilton and one bag to Eugenius Wilson. Lincoln district, one bag to S. E. Fleming, and one bag to T. R. Hall, in Winfield district.

The wheat was delivered to all except Messrs. B. D. and M. L. Fleming, who failed to get the bags left for them from the depot, which fact did not come to my knowledge until in the spring when I had the two bags taken home and this fall had them carefully seeded by a neighbor. I would rather you would turn the price of those two bags into the Station funds, and draw on me for the amount. I have been informed that the wheat sent to Mannington district, was received too late to be seeded and was not, in fact, sown until this fall. This I only have from hearsay, as I have failed to hear personally from any of the parties. I enclose you the only report I have received; namely, from Captain Gray. I hope to hear from some others within a few days. I expected a very careful report from O. P. Floyd, who was one of our best farmers and a very painstaking man, but he died about the time the wheat was harvested. I regret very much the delay in this matter, but I could not help it.

Very truly yours,
C. L. SMITH.

SECOND DISTRICT.

Variety of wheat tested, "Lancaster."

Quality of seed was good.

Sowed 1 bushel per acre November 8th., on tough, white oak soil, prepared in the usual way. Condition of soil at time of sowing was very wet. Corn was growing on the land in 1887. Yield 50 bushels per acre. In 1886 in grass, in 1885, grass. Soil is considered medium. Wheather following sowing was very wet. Stand of wheat secured in the fall was thin. Crop stood frost very well, best of any I had. Crop grew tall. Ripened July 4th. Yield 19 bushels per acre.

I think it a good wheat.

JNO. B. GRAY,
Fairmont, W. Va.

RECEPITULATION FOR THE SECOND DISTRICT.

"NAIL CLUB."

Considered the best wheat ever grown.

"SOLID GOLD."

Considered excellent for high, thin land.

"MICHIGAN BRONZE."

Better than either "Fultz" or "Pool."

"LANCASTER."

Considered a good wheat.

	24 tests were sent to this district, of which
	4 were reported upon as follows:
"Nail Club."	1 report favorable.
	0 reports unfavorable.
"Solid Gold"	1 report favorable.
	0 reports unfavorable.
"Michigan Bonze"	1 report favorable.
	0 reports unfavorable.
"Lancaster."	1 report favorable.
	0 reports unfavorable.

THIRD DISTRICT.

Variety of wheat tested "German Amber."

Quality of seed received was very good.

Sowed 1¼ bushels November 1, 1888, on yellow clay soil, prepared by plowing in the wheat with a shovel plow. The ground was too wet to use another plow. The condition of soil at time of sowing was not at all good, being too wet. The land in 1887 was in corn. Yield 50 bushels per acre. In grass the year before. The soil is considered a very good clay for wheat. Weather following sowing was rather rainy. No hard freezing during the winter. Stand secured in the fall was very good, but scarcely made a show before March. So far as I was able to observe there was no fly, rust, or anything, to interfere with or attack the wheat. It stood the winter well, and I will sow it this fall. It grew vigorously the whole spring. Ripened July 4th. Yield nineteen bushels. It is a splendid wheat, in my opinion, for this locality. A number of persons inquired as to the name of the wheat, and admired it from first to last. Think it an excellent, hardy wheat. Yield big, but the fall was so wet that I was delayed in sowing more than a month. It ought to be sown in October or September. I intend to sow 10 bushels in bottom land the present month.

D. BASSEL,

Lost Creek, Harrison county, W. Va.

Variety of wheat tested "Purple Straw."

Quality of seed good.

Sowed 1¼ bushels per acre October 31st, 1888, on red clay soil prepared by plowing the wheat in with a shovel plow. Weather

VOLUME III NUMBER 8.

Bulletin No 32

WEST VIRGINIA

Agricultural Experiment Station

MORGANTOWN, W VA.

CATALOGUE

OF

West Virginia Forest and Shade Tree

INSECTS.

MAY, 1893.

CHARLESTON, W. VA.
MOSES W. DONNALLY, PUBLIC PRINTER.
1893.

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CATALOGUE

OF

WEST VIRGINIA FOREST AND SHADE TREE INSECTS.

Collected in 1890-1893, Including Injurious, Beneficial and other Insects Taken on or in Some Part of the Tree Examined.

By A. D. Hopkins.

INTRODUCTORY*.

The depredations by insects on certain forest and shade trees of West Virginia during the past three years have been such as to demand special investigation, with a view of finding the species responsible for the primary cause of the premature death of trees; also to discover, if possible, methods of repelling or destroying them.

Insects injurious and beneficial to the Yellow Locust, the Black Spruce and the Pines have claimed the greater share of my attention, yet at the same time, such insects as were found on or in other kinds of trees and shrubs were collected and their habits, so far as observed, noted.

These investigations have not, as yet, been sufficiently completed to justify a detailed report of the work and results; therefore this catalogue is sent out in advance of more popular bulletins on the subject to be issued at the end of another season's work.

This catalogue and the one preceding it on West Virginia Scolytidæ are issued in this form, and in small editions not for general distribution, but for those who may be interested in such records of original observation, on the habits and life histories of forest, shade and fruit tree insects

The species herein mentioned have been collected or bred by me during the past three years, and the reference to habits, dates, etc., are from my notes and records.

It is my intention to continue the study of the life histories of forest tree insects, and to publish from time to time supplements to these catalogues containing lists of additional species found, together with necessary corrections and revisions.

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*See also introductory to Catalogue of W. Va., Scolytidæ Bulletin 31, 1893.

My time being devoted almost exclusively to the study of insects from an economic standpoint, I have little time for systematic study, except on the family Scolytidæ; therefore I shall, as heretofore, depend largely upon the authoritative specialists for determinations of species.

I desire, in this connection, to acknowledge the kindness of the following named persons who have made first determinations for me of species in orders and families in which they are specialists: Dr. C. V. Riley, Mr. L. O. Howard, Mr. William Ashmead, Mr. E A. Schwarz, of the Division of Entomology at Washington; Dr. G. H. Horn, of Philadelphia, Dr. W. J. Holland, of Pittsburg; Mr. W. H. Edwards, of Coalburg, W Va.; Prof C. H. Tyler Townsend, of Los Cruces, N. M.; and Oberforester W. Eichhoff, of Strassburg, Germany.

Exhibit Collections.

Two exhibit collections have been prepared during the past winter One for the exhibit by the Association of Agricultural Colleges and Experiment Stations in the Agricultural Building; the other for the West Virginia Exhibit in the Forestry Building at the World's Columbian Exposition. The former consists of West Virginia Scolytidæ and some of their enemies, and contains 299 insects and 284 wood and bark specimens, showing character of damage to wood and bark of forest, shade, fruit trees, etc. The latter consists of West Virginia forest and shade tree insects and examples of their work in wood and bark, including 240 insects and 250 other specimens. The species numbered in heavy type in this catalogue are represented in this collection.

These exhibits, aside from indicating the character of work in Entomology carried on by the West Virginia Experiment Station are designed to call the attention of owners of timber and others, who are interested in the preservation of our forests, to the importance of earnest and careful investigations, with a view of becoming better acquainted with the habits and life histories of the insects which cause such great damage and loss.

Order COLEOPTERA; Family CARABIDÆ.

1. **Cychrus Ridingsii,** Bland.
   Collected under bark on spruce log.
   Adult September 2.
   Randolph county.

2. **Tachys nanus,** Gyll.
   Collected under bark on spruce log
   Adult September 1.
   Randolph county.

3. **Pterostichus adoxus,** Say.
   Collected under bark on decaying spruce stump.
   Adults September 1.
   Randolph county.

4. **Pterostichus honestus,** Say.
   Collected under bark on spruce log.
   Adult September 1.
   Randolph county.

5. **Platynus angustatus,** Dej.
   Collected under bark on spruce stump.
   Adults September 1; July 11.
   Randolph and Grant counties.

6. **Platynus sinuatus,** Dej.
   Collected under dead bark on spruce log.
   Adult September 1.
   Randolph county.

7. **Dromius quadricollis,** Lec.
   Collected under bark on spruce log.
   Adults March 30.
   Grant county.

8. **Chlænius tricolor,** Dej.

Collected under bark on Spruce log.

Adult September 1.
Randolph county.

Order COLEOPTERA; Family STAPHYLINIDÆ.

9. **Homalota** sp

With *Tomicus caelatus*, *Tomicus pini*, *Polygraphus*, *rufipennis* in Spruce and *Dendroctonus frontalis* in Pine.

Adults September 1, 22, 25; October 21, 22; April 14, 17; May 4, 30; July 13.
Randolph, Monongalia, Tucker, Wood and Pendleton counties.

10. **Quedius peregrinus,** Grav.

With Scolytids under spruce bark.

Adult August 29.
Randolph county.

11 **Xantholinus cephalus,** Say.

On bark of Black Spruce tree infested with Scolytids.

Adults March 29.
Tucker county.

12. **Baptolinus longiceps,** Fab.

With *Polygraphus rufipennis* in Spruce bark.

Adult September 1; March 28.
Randolph and Tucker counties.

13. **Olophrum obtectum,** Er.

Collected under Pine bark.

Adult October 17.
Wood county.

14. **Siagonium americanum,** Melsh.

With *Dryocoetes autographus* in Spruce bark, and *Dryocoetus n. sp.* in Birch bark.

Adults May 8; July 11. Larvæ May 8.
Tucker and Grant counties.

Order COLEOPTERA; Family PHALACRIDÆ

15. **Olibrus bicolor,** Gyll.

Adults in Spruce bark and on Locust leaves. Larvæ in Ergot on grass.

Adults March 10; July 9; August 29; May 21. Larvæ July 9.
Wood, Randolph and Gilmer counties.

Order COLEOPTERA; Family CORYLOPHIDÆ.

16 **Sacium biguttatum**, Lec.

Under bark on dead Beech.

Adults August 22.
Tyler county.

Order COLEOPTERA; Family COCCINELLIDÆ.

17. **Hippodamia convergens**, Guer.

PREDACEOUS.

Attacks Aphids on Apple and Locust

Adults July 17, 20; August 8, 24, 25; September 7; October 4; May 4
Wood, Monongalia, Marshall, Brooke, Tucker and Jackson counties.

18 **Coccinella 9-notata**, Hbst.

PREDACEOUS.

Attacks Aphids on Locust and Apple.

Adults April 17, 18; June 24; July 2, 11, 17, 20, 30; October 3.
Webster, Wood, Marshall, Monongalia, Randolph, Cabell and Wirt counties

19. **Coccinella sanguinea**, Linn.

PREDACEOUS.

Attacks Aphids on Cherry, Locust and Apple.

Adults June 25, 26; July 7; August 7; September 7; October 4.
Monongalia, Wood and Upshur counties.

20. **Adalia bipunctata**, Linn.

PREDACEOUS.

Attacks Aphids on Locust, Box Elder, Apple and Balm of Gilead.

Adults June 1, 11; July 16, 20; August 1, 7; September 7. Pupæ June 1. Larvæ June 1.
Hancock, Cabell, Monongalia and Marshall counties.

21. **Anatis 15-punctata**, Oliv.

PREDACEOUS.

Attacks Aphids on Box Elder.

Adults April 27; June 11; July 21. Pupæ June 11. Larvæ June 11
Monongalia, Wood and Wetzel counties.

Order CLEOPTERA: Family ENDOMYCHIDÆ.

22. **Endomychus biguttatus**, Say.
With Scolytids under Pine bark.
Adults October 15; December 6.
Marion and Monongalia counties.

Order COLEOPTERA; Family COLYDIIDÆ.

23. **Coxelus guttulatus**, Lec.
Under dead bark on Beech and Pine.
Adults May 6; July 22.
Hampshire and Tyler counties.

24. **Aulonium parallelopipedum**, Say.
Under bark on dead Beech and Black Oak.
Adults July 30; August 22.
Tyler and Wood counties.

25. **Aulonium tuberculatum**, Lec
With Scolytids in Pine bark.
Adults July 13
Hampshire county.

26. **Colydium lineola**, Say.
PREDACEOUS.
With *Platypus quadridentatus* in sap wood of Black Oak; *Xyloterus politus* in Maple; *Monarthrum mali* in Jack Oak; in Scolytid mines in Pine bark.
Adults July 13, 29, 30; August 19, 27; September 12
Hampshire, Wayne, Tyler, Monongalia and Wood counties.

27. **Sosylus costatus**, Lec.
PREDACEOUS.
With *Platypus quadridentatus* in Black Oak.
Adult July 29.
Wayne county.

28. **Philothermus glabriculus**, Lec.
With Scolytids under Spruce bark.
Under dead Locust bark.
Adults August 29; October 11.
Randolph and Monongalia counties.

Order COLEOPTERA; Family CUCUJIDÆ.

29. **Silvanus planatus**, Germ.
Under bark on dead Yellow Locust.
Adults March 18.
Wood county.

30. **Catogenus rufus**, Fab.
Under bark on dead Sugar Maple.
Adults April 12.
Monongalia county.

31. **Cucujus clavipes**, Fab.
Under bark on dead White Oak.
Adults February 25.
Preston county.

32. **Dendrophagus glaber**, Lec.
Under bark on Spruce log.
Adults September 1.
Randolph county.

33. **Brontes dubius**, Fab.
Under bark on dead Locust.
Adults April 9.
Wood county.

Order COLEOPTERA; Family MYCETOPHAGIDÆ.

34. **Litargus 6-punctatus**, Say.
Under bark on dead Beech.
Adults April 17.
Wood county.

35. **Diplocoelus brunneus**, Lec.
Under bark on dead Beech.
Adults August 22.
Tyler county.

Order COLEOPTERA; Family HISTERIDÆ.

36. **Hololepta fossularis**, Say.
Under bark on dead and dying Populus, Hickory and Locust.
Adults April 5; June 13; August 8; October 11; Eggs October 11.
Wood county.

37. **Hister parallelus**, Say.
With *Dryocoetes autographus* in Spruce. *Tomicus Cacographus* and *Gnathotrichus materiarius* in Pine
Adults May 18; June 24, 29; July 20; November.
Monongalia, Wood and Marshall counties.

38. **Hister cylindricus**, Payk.
With *Tomicus cacographus* and *Tomicus calligraphus* in Pine bark.
Adults, May 5, 8; August 12.
Wood and Pendleton counties.

39. **Paromalius estriatus**, Lec
Under Hickory and Black Oak bark.
Adults March; July 30; October 27.
Wood and Monongalia counties.

40. **Paromalus bistriatus**, Er.
With *Polygraphus rufipennis* in Spruce bark.
Adults July 11; August 30.
Randolph and Tucker counties.

41. **Paromalus difficilis**, Horn.
With *Polygraphus rufipennis* and *Dryocoetes affaber* in Spruce bark.
Adults July 8; August 28; September 1; Pupæ July 8.
Randolph county.

42. **Plegaderus transversus**, Say
With *Tomicus cacographus* in Pine bark.
Adults June 24, 29; July 20.
Wood and Marshall counties.

Order COLEOPTERA; Family NITIDULIDÆ.

43. **Colastus unicolor**, Say.
With *Pityophthorus confinis* and *Tomicus calligraphus* under bark on dead pine
Adults May 4.
Pendleton county.

44. **Epuræa avara**, Rand.
Under dead bark on Spruce logs.
Adult July 8.
Grant county.

45. **Epuræa truncatella**, Mann.
With *Polygraphus rufipennis* in Spruce bark.
Adults March 26; July.
Tucker and Grant counties.

46. **Prometopia 6-maculata**, Say.
Under bark on dead Beech.
Adults August 22.
Tyler county.

47. **Cryptarcha ampla**, Er.
With *Cyllene robiniæ* larvæ under bark on living Yellow Locust tree
Adults May 1
Wood county.

48. **Ips fasciatus**, Oliv.
With *Cyllene robiniæ* larvæ under bark on living Yellow Locust tree and *Xyloterus bivittatus* on Spruce log.
Adults March; April 5; May 1, 9
Wood county.

49. **Nitidulidæ larvæ**.
Ips fasciatus?
With *Xyloterus bivittatus* in Spruce wood; *Platypus compositus* in Bass wood. With *Cyllene robiniæ* larvæ in Locust bark on green tree.
Larvæ May 14; June 1; July 9, 21.
Wood and Grant counties.

50. **Ips sanguinolentus**, Oliv.
With *Xyloterus politus* under Sugar Maple bark; also feeding on Black Walnut sap.
Adults April 5; May 9.
Wood and Grant counties.

51. **Rhizophagus dimidiatus**, Mann.
With Scolytids under Spruce bark.
Adults March 26; September 1.
Randolph and Tucker counties.

52. **Rhizophagus bipunctatus**, Say.
Under bark on dead Beech with *Monarthrum fasciatum* and with *Dryocoetes n. sp.* in Birch bark.
Adults March 21; April 18; October 21.
Wood, Pendleton and Monongalia counties.

Order COLEOPTERA; Family LATHRIDIIDÆ

53 **Latridius maculatus**, Lec.
Under bark on dead Beech.
Adults October 21.
Wood county.

54. **Latridius opaculus**, Lec.
Under bark on dead Beech
Adults October 21.
Wood county.

55. **Corticaria sp.**
On Yellow Locust leaves.
Adult May 21.
Wood county.

56. **Corticaria elongata**, Hum.
With *Tomicus calligraphus* under bark on Pine.
Adults July 27.
Wirt county.

Order COLEOPTERA; Family TROGOSITIDÆ.

57. **Nemosoma cylindricum**, Lec.
With *Tomicus cacographus* in Pine bark.
Adults May 20.
Wood county.

58. **Trogosita virescens**, Fab.
Under bark on dead and dying White and Yellow Pine trees.
Adults May 4; July 20.
Marshall and Hampshire counties.

59. **Tenebrioides corticalis**, Melsh
Under bark on dead Apple tree, and with *Phloeotribus frontalis* in bark of live Mulberry.
Adults September 7. Pupæ April 25. Adult emerged May 12.
Monongalia and Wood counties.

60. **Tenebrioides castanea**, Melsh.
Under bark on dead Beech.
Adults August 22.
Tyler county.

61. **Bactridium ephippigerum**, Guer.

Under partly green bark on Basswood log, and under bark on dead Beech

Adult April 17; July 21.
Wetzel and Wood counties.

Order COLEOPTERA; Family ELATERIDÆ.

62. **Tharops ruficornis**, Say.

WOOD BORER.

In dead Beech wood and on bark of dead maple.

Adults May 27; June 16; July 10.
Grant, Randolph and Monongalia counties.

63. **Alaus oculatus**, Linn.

WOOD. BORER.

In green Oak wood and in decaying wood.

Adults June 19. Larvæ May 8; March 10.
Wood county.

64. **Hemirhipus fascicularis**, Fab.

PREDACEOUS.

Larva attacks *Cyllene picta* larvæ in Mulberry wood.

Adults bred June 5; Larvæ April 9.
Wood county.

Order COLEOPTERA; Family BUPRESTIDÆ.

65. **Chalcophora campestris**, Say.

BARK BORER.

Said to infest dead and dry Sycamore, (Packard).

Adults flying May 18; June 10.

66. **Dicerca divaricata**, Say.

BARK BORER.

Attacks bark on dead Peach tree.

Collected Adults May 11; July 12; September 12.
Wood and Randolph counties.

67. **Dicerca obscura**, Fitch.

BARK BORER.

On dead Oak branch.

Adult May 18.
Wood county.

68. **Dicerca lurida**, Fab.

BARK AND WOOD BORER.

Said to attack Pig Nut Hickory (Harris).

Adult flying May 2.
Wood county.

69. **Buprestis rufipes**, Oliv.
Adult flying July 20, August 19.
Monongalia county.

70. **Buprestis lineata**, Fab.
Adult flying June 21.
Wood county.

71. **Melanophila fulvoguttata**, Harv.

BARK BORER.

Infests green bark on living, injured and dying Hemlock trees.

Adults March 31; May 9: June 16; July 17.
Upshur and Grant counties.

72. **Melanophila sp. a**.

BARK BORER.

Collected on Spruce logs.

Adult June 21.
Randolph county.

73. **Anthaxia æneogaster**, Lap.

BARK BORER.

Infests bark on dying Hickory trees.

Adults April 23; May 21.
Wood county.

74. **Anthaxia viridicornis**, Say.

BARK BORER.

Infests dying Willow and Spruce?

May 4; June 25; August 30; September 11.
Wood and Randolph counties.

75. **Anthaxia flavimana**, Gory.

TWIG BORER.

Infests dying Plum branches.

Adult May.
Wood county.

76 **Chrysobothris femorata**, Fab.

BARK AND WOOD BORER.

Infests bark on logs, stumps, injured and dying trees; White Oak, Black Oak, Apple, Hickory, Maple, Basswood

Adults May 1, 15, 18, 20; June 16, 23; July 20, 27. Larvæ March 20 and November to April.

Wood, Grant, Wetzel, Upshur and Monongalia counties.

77. **Chrysobothris pusilla**, Lap. and Gory.

BARK BORER.

Collected on Spruce logs.

Adults September 1.

Randolph county.

78. **Chrysobothris azurea**, Lec.

BARK AND WOOD BORER.

Infests Pine Bark and wood on branches of dead trees

Adults May 3, 5, 15.

Wood, Hampshire and Grant counties.

79 **Acmæodera ornata**, Fab.

Adults flying June 16, 24.

Wood county.

80. **Acmæodera culta**, Web.

WOOD BORER.

Infests bark and wood of dead Hickory. Adults found on Locust leaves, Dandelion and Wild Rose Blossoms.

Adults May 18, 21; June 23; September 15.

Wood and Monongalia counties.

81. **Buprestid sp**, c.

On dead Hickory.

Adult July 24.

Monongalia county.

82. **Agrilus otiosus**, Say.

BARK BORER.

Infests bark on dead twigs and branches of Hickory, Black Walnut. Adults feed on Walnut and Hickory leaves.

Adults April 14, 23; May 15, 18, 21, 30; July 4, 16, 25.

Wood, Upshur, Calhoun and Monongalia counties.

83. **Agrilus bilineatus**, Web.

BARK BORER.

Infests green bark on stumps, living, injured and dying trees. May cause the death of trees. Infests White Oak, Black Oak and Chestnut.

84. **Agrilus fallax**, Say.

BARK BORER.

Infests bark and wood of dying branches on living and dying Hackberry.

Adults May 2.
Wood county.

85. **Agrilus politus**, Say.

BARK BORER.

Infests green bark on living Willow trees. May be the primary cause of death of young trees

Adults June 13, 27. Pupæ May 4; June 27 Larvæ May 5, 20.
Grant and Wood counties.

86. **Agrilus egenus**, Gory.

BARK BORER.

Larvæ infests bark on dead and dying branches on living and dying Yellow Locust trees; adults feeding on leaves, common.

Adults April 24; May 15, 18, 20, 21, 30; June 1, 13, 15, 16, 27; July 16. Pupæ May 20; Larvæ May 20.
Monongalia, Wood and Hancock counties.

87. **Agrilus sp. b.**

BARK BORER.

Infests green bark on White Oak stumps.

Adults April 29; June 25.
Wood county.

88. **Agrilus sp. c.**

BARK BORER.

Infests green bark on living and dead Dogwood.

Adult April 14
Wood county.

Order COLEOPTERA; Family LAMPYRIDÆ

89. **Lucidata atra,** Fab.

Under dead bark on Spruce and Apple trees.

Adults March 29; June 16; November 2.
Wood, Monongalia and Tucker counties.

90. **Ellychnia corrusca,** Linn.

Common on Spruce bark.

Adult March 29.
Tucker county.

91. **Chauliognathus pennsylvanicus.** De G.

PREDACEOUS.

Larvæ attacks *Ecdytolopha insiticina* (Locust Twig Borer) in Yellow Locust twig.

Larvæ September 17.
Monongalia county.

Order COLEOPTERA; Family MALACHIDÆ.

92. **Attalus scincetus.** Say.

With *Scolytus rugulosus* in Apple bark

Adult March 21.
Monongalia county.

Order COLEOPTERA; Family CLERIDÆ.

93. **Elasmocerus terminatus,** Say.

PREDACEOUS.

With *Sinoxylon basilare, Agrilus otiosus* and *Chramesus icoriæ* in dead Hickory branches.

Adults flying June 22. Adults bred from Hickory April 23.
Wood and Monongalia counties.

94. **Cymatodera bicolor,** Say.

PREDACEOUS

With *Phlœosinus dentatus?* in Cedar bark.

Adult May 15.
Wood county.

95 **Cymatodera inornata**, Say.

PREDACEOUS.

In outer bark on green Pine. Probably attacks *Hymenopterous* insects.

Adult October 15.
Marion county.

96. **Clerus quadrisignatus**, Say. **var nigripes**, Say.

PREDACEOUS.

With *Tomicus cacographus* and *Pityophthorus pullus* in Pine bark and with *Phloeosinus dentatus* in Red Cedar bark.

Adult May 4, 9
Grant county.

97. **Clerus sp. a.**

PREDACEOUS.

In pith of dead Sumach. Probably attacks *Adynerus* sp

Adults bred April 20; June 25. Larvæ April 1.
Wood county.

98. **Thanasimus trifasciatus**, Say.

PREDACEOUS.

With *Polygraphus rufipennis* under Spruce bark.

Adult March 28; August 29. Larva March 28.
Randolph and Tucker counties.

99. **Thanasimus dubius**, Fab.

PREDACEOUS.

Attacks *Tomicus cacographus*, *Tomicus calligraphus* *Dendroctonus frontalis*, *Pityophthorus pullus*, *Pityophthorus tuburculatus*, *Pityophthorus sp. d.* in Pine bark; *Polygraphus rufipennis* in Spruce bark and *Hylesinus opaculus* in Elm bark.

Adults May 2, 8, 30; August; September 1; October 6; November; Larvæ March 28, 31; May 3; July 21, 30; August 29; September 7, October 6, 10, 21.

Randoph, Tucker, Hampshire, Monongalia, Grant and Wood counties.

100. **Clerus formicarius**, L.
Thanasimus formicarius, L.

The European Bark Beetle Destroyer. Destructive to Scolytids in European coniferous forests. One thousand live specimens of adults, larvæ and pupæ imported to America in October, 1892, by the West Virginia Experiment Station, aided by owners of the forests. First adults collected by me in Government forest of Pinus sylvestris near Hagenau, Elsace, Germany, August 29th, 1892. First adults set free in America, in Pine forests near Morgantown, West Virginia, on October 10th, 1892.

101. **Thaneroclerus sanguineus**, Say.

PREDACEOUS.

On Hemlock stump with *Xyloterus bivittatus*.

Adult May 8.
Grant county.

102. **Phyllobænus dislocatus**, Say.

PREDACEOUS.

Attacks *Polygraphus rufipennis* in Black Spruce and *Pityophthorus consimilis* in Sumach (Rhus glabra) and with *Scolytus rugulosus* in Apple bark.

Adults bred June 16, 20, 22; December 7.
Randolph and Monongalia counties.

103. **Chariessa pilosa**, Forst.

PREDACEOUS.

Under bark on dead Walnut and in dead grape vine.

Adults April 15; May.

104. **Enoplium quadripunctatum**, Say.

PREDACEOUS.

Bred from dead Black Walnut branches.

Adult April 8.
Wood county.

105. **Orthopleura damicornis,** Fab.

PREDACEOUS.

With Buprestid larvæ in Dry Hickory wood.

Adults July 27.
Wood county.

106. **Clerid larvæ, sp. a.**

PREDACEOUS.

With *Dendroctonus frontalis*, *Tomicus avulsus* and *Tomicus cacographus* larvæ in Pine bark.

Larvæ June 23, 29; October 14.
Wood county.

107. **Clerid larvæ, sp. b.**

PREDACEOUS

With *Polygraphus rufipennis*, larvæ in Spruce.

Larvæ July 23; March 26.
Tucker and Wetzel counties.

108. **Clerid larvæ, sp. c.**

PREDACEOUS

With *Phlœotribus liminaris* in Wild Cherry and *Scolytus rugulosus* in Apple bark.

Larvæ March 2; July 13.
Monongalia county.

109. **Clerid larvæ, sp. d.**

PREDACEOUS.

With *Scolytus rugulosus* in Apple bark; *Scolytus quadrispinosus* in Hickory bark and *Scolytus muticus* in Hackberry bark.

Larvæ March 2; July 20; October 7; November 23.
Marshall and Monongalia counties.

110 **Clerid larvæ, sp. e.**

With *Tomicus Pini* in Pine bark.

Larvæ July 20.
Marshall county.

111. **Clerid larvæ, sp. f.**

With Cerambycid larvæ in Black Walnut bark.

Larvæ March 2.
Monongalia county.

Order COLEOPTERA; Family PTINIDÆ.

112. **Xestobium squalidum,** Lec.

WOOD BORER.

Infests dead wood of Black Spruce.

Adults bred. Larvæ collected March 31; May 9.
Grant county.

113. **Ptilinus ruficornis,** Say

WOOD BORER.

Infests dead and dry wood where the bark has been removed on living trees, logs and stumps of Beech, Wild Cherry, Maple, Cultivated Cherry, Iron wood.

Adults Feb. 17; April 12; June 10, 25, 27; July 10, 17.
Wood, Monongalia and Grant counties.

114. Sinoxylon basilare, Say.

"POWDER POST" WOOD BORER.

Infests wood of dead Hickory and Mulberry.

Adults April 14, 23; May 4, 15, 22. Larvæ May 4; March 18.
Wood county.

115. **Bostrychus bicornis,** Web

WOOD BORER.

Infests dead wood of Beech, Elm? Apple?

Adults July 16, 30; Aug. 20.
Hancock, Wayne, Monongalia and Wood counties.

116. Lyctus striatus, Melsh.

"POWDER POST" BEETLE.

WOOD BORER.

Infests seasoned wood of Hickory, Yellow Locust, Wild Cherry. Very injurious to stored handles, spokes, hoops, &c.

Adults bred Feb. 17, 29; June 23; July 7. Larvæ Jan. 1, 9.
Grant, Monongalia, Pocahontas and Marshall counties.

Order COLEOPTERA ; Family LYMEXYLIDÆ.

117. Hylecœtus? larva, sp. a.

OAK TIMBER WORM.

Infests wood of White Oak Logs and trees. Cause "pin holes" in heart-wood and sap wood Very injurious

Larvæ, Mar. 15.
Wood county.

118. Lymexylid larva, sp a.

WOOD BORER.
CHESTNUT TIMBER WORM.

Infests wood of living, injured and dead Chestnut trees and logs. Causes "pin holes" in wood.

Larvæ May 20; July 29.
Wood county.

119. **Lymexylon, sp. a.**

WOOD BORER.

Infests wood of dying Hemlock trees.

Adult bred. Larvæ April 1.
Marion county.

120. **Lymexylon? larvæ sp. b.**

WOOD BORER.

Infests wood of Magnolia logs. Causes "pin holes" in wood.

Larvæ July 21.
Marshall county.

121. Lymexylon(?) sp. c.

WOOD BORER.

Larvæ bore through the outer sap wood just beneath the surface and directly across the grain of the wood of large Aspen.

Adults bred April 1. Pupæ March 27; Larvæ August 10; November 7; March 27
Monongalia county.

Order COLEOPTERA: Family SCARABÆIDÆ.

122. **Clœotus aphodioides**, Ill.

Under bark on dead Chestnut Oak tree,

Adults July 30.
Wood county.

123. **Clœotus globosus**, Say.

Under bark on dead Black Oak.

Adults July 30.
Wood county.

124. **Macrodactylus subspinosus**, Fab.

ROSE BEETLE.
FOLIAGE FEEDER.

Infests Yellow Locust and many other forest and shade trees.

Adults May 30; June 12, 16, 23.
Wood and Monongalia counties.

125. **Lachnosterna fusca**, Froh.

MAY BEETLE.
FOLIAGE FEEDER.

Adults infest Oaks, Persimmon and many other forest and shade trees, occasionally defoliating large trees. Larvæ feed on roots of grass, &c. Common throughout the State.

126. **Lachnosterna hirticula**, Knoch.

MAY BEETLE.
FOLIAGE FEEDER.

Infests Oaks and other forest and shade trees. Defoliates large trees.

Adults in company with above species defoliating Oak forest in Greenbrier county June 15, as reported by Editor of "Greenbrier Independent."

127. **Valgus canaliculatus**, Fab.

Infests decaying wood of Pine and Peach stumps.

Adult Feb.
Wood county.

Order COLEOPTERA; Family SPONDYLIDÆ.

128. **Parandra brunnea**, Fab.

Under bark on dead Beech.

Adults July 30.
Wayne county.

Order COLEOPTERA ; Family CERAMBYCIDÆ.

129. **Prionus laticollis**, Drury.

WOOD BORER.

Infests dead wood of Pine stumps, Roots of living Black Oak and wood of Oak logs?. Probably a destructive species.

Adults July 20; Aug; Pupæ June 20; Larvæ? June; Eggs July.
Upshur, Monongalia and Wood counties.

130. **Asemum moestum**, Hald.

WOOD BORER.

Infests wood near base of stumps and dying Pine and Spruce trees. Hastens death of trees and decay of wood.

Adults April 20; May 8; June 21. Pupæ April 20; Larvæ April 20; September 2.
Wood and Randolph counties.

131. **Tetropium cinnamopterum**, Kirby.

BARK AND WOOD BORER.

Infests green bark and wood on injured and dying Black Spruce trees. Very injurious. Hastens death of trees and causes rapid decay of wood.

Adults March 31; July 9. Larvæ March 29; 31; July 7.
Grant and Tucker counties.

132. **Smodicum cucujiforme**, Say.

BARK BORER.

Under bark of dead Hòney Locust, Beech and Elm.

Adults June 25; July 16, 20.
Wood, Wetzel and Hancock counties.

133. **Phymatodes variabilis**, Fab

THE WHITE OAK PHYMATODES

BARK AND WOOD BORER.

Infests White Oak, (Packard.)

Adults flying May 9, 21; June 15, 16.
Wood and Harrison counties.

134. **Phymatodes dimidiatus**, Kirby.

BARK BORER

In bark of Spruce log.

Adults June 21, 23. Larvæ June 12.
Monongalia, Pendleton and Randolph counties.

135. Callidium antennatum, Newm.

WOOD BORER.

Infests wood of dying and dead Pine trees. Causes rapid decay of wood.

Adults collected May 3. Also bred later. Larvæ May 3 to 6. Hampshire county.

136 **Chion cinctus**, Drury.

WOOD BORER.

Infests dead branches of Black Oak.

Adults June 16; Larvæ March 18; December 20.
Wood county.

137. **Eburia quadrigeminata**, Say.

WOOD BORER

On dead Beech and Elm. Probably infests these trees.

Adults July 17, 20, 22.
Wetzel, Tyler and Brooke counties.

138. Elaphidion mucronatum, Fab.

WOOD BORER.

Infests dead bark and wood of Beech Green wood of living Sugar Maple and bark of Black Oak.

Adults collected July 14, 25; August 1, 19. Bred Larvæ November 26. Adults emerged later.
Wood, Webster, Cabell and Monongalia counties.

139. Elaphidion parallelum, Newm.

OAK PRUNER.
TWIG BORER.

Infests small, living branches of Black Oak, Jack Oak and Walnut. Causes the branches to break and fall

Adults January; February 2; March 13. Larvæ July 29; August 6.
Wood and Monongalia counties.

140. **Molorchus bimaculatus**, Say.

WOOD BORER.

Infests dead twigs on living Black Walnut trees and dying wood of Dogwood.

Adults bred April 8, 14; Larvæ April 14.
Wood county.

141. **Purpuricenus humeralis**, Fab.

Collected on Oak leaves.

Adults collected June 23.
Wood county

142. **Batyle ignicollis**, Say.
Adults collected July 15.
Wood county.

143. **Cyllene pictus**, Drury.

WOOD BORER.

Infests dead branches and small trees, Mulberry and Hickory.

Adults April 9, 14; Pupæ April 9. Larvæ April 9.
Wood county.

144. **Cyllene robiniæ**, Forst.

THE LOCUST BORER.

Infests live bark and wood of healthy Yellow Locust trees. Very injurious and destructive. The primary cause of death of trees.

Adults August 25; Sept 16, 17. Larvæ May 1, 20.
Monongalia. Mineral and Wood counties.

145. **Arhopalus fulminans**, Fab.

WOOD BORER.

Infests sap wood of Oak, Chestnut and Hemlock logs Causes large worm holes in outer wood. Hastens decay.

Adults April 18; May 12, 20; June 16; July 5, 24; Aug. 10.
Pupae April 18. Larvae 18. Eggs Aug. 10.
Wood, Calhoun and Monongalia counties.

146 **Xylotrechus colonus**, Fab

WOOD BORER.

Infests bark and wood of logs and dead trees of Black Oak, White Oak, Hickory, Chestnut, Ash, Elm. Hastens decay of wood.

Adults May 8, 11, 15, 20; June 25; July 3. Pupae April 23; Larvae April 12, 18.
Wood, Monongalia and Calhoun counties.

147. **Neoclytus luscus**, Fab.

BARK AND WOOD BORER.

Attacks dead Ash.

Adult Aug. 10. Eggs? Aug. 10.
Monongalia county.

148. **Neoclytus capræa**, Say.

WOOD BORER.

Infests saw logs and dying trees of Black Ash. Very injurious to saw logs, boring numerous holes through the wood

Adults emerging March 19; May 30. Pupæ March 20. Larvæ March 19, 20, 24.

Wood county.

149. **Neoclytus erythrocephalus**, Fab.

WOOD BORER

Mining in bark and sap wood of dying and dead trees. Infests Locust, Hickory, Oak, Persimmon, Maple, Elm, Willow, Peach Apple.

Adults May 1, 15, 19, 20, 21; July 14, 24; August 4; September 2. Pupæ March 18; May 1.

Wood, Monongalia, Tucker, Randolph and Kanawha counties.

150. **Clytanthus ruricola**, Oliv.

WOOD BORER.

Infests dead Sugar Maple.

Adults April 12; June 15.

Harrison county.

151. **Distenia undata**. Oliv.

BARK AND WOOD BORER

Collected adult under loose bark on dead Chestnut.

Adult July 25.

Wood county.

152. **Rhagium lineatum**, Oliv

BARK BORER.

Mining under bark of dying trees. Changing to beetle in chip, cocoons under bark. Infests pines.

Adults April 8; May 5, 9; Oct. 17; Dec. 19. Pupæ Oct. Larvæ July 14.

Common in pine forests.

153. **Monohammus scutellatus**, Say.

WOOD BORER

WHITE PINE "SAWYER."

Boring in sap and heart wood of saw logs, dying and dead trees. Cause large holes in wood. Hastens decay. Very injurious to timber. Infests White Pine.

Adults May 5; Larvæ June 23; Oct 10.

Pendleton and Marion counties.

154 **Monohammus confusor**, Kirby.

WOOD BORER.
SPRUCE SAWYER.

Boring large holes in saw logs and dying trees. Infests Black Spruce

Adults Aug. 29.
Randolph county.

155. **Monohammus marmorator**, Kirby.

WOOD BORER
PINE SAWYER.

Boring large holes in saw logs, dying and dead trees. Infests Yellow, Pitch and Scrub Pines.

Adults July 12, 24.
Monongalia county,

156. **Dorcaschema nigrum**, Say.

Flying in Spruce forest.

Adult June 23
Pendleton county.

157. **Goes oculatus**, Lec.
Adult collected flying July 14.
Randolph county.

158. **Leptostylus aculiferus**, Say.

BARK AND WOOD BORER.

Infests dead and dying Apple and Maple trees.

Adults April 19; June 13, 18.
Monongalia and Wood counties.

159. **Liopus variegatus**, Hald.
Adult collected flying Oct. 3.
Monongalia county.

160 **Liopus alpha**, Say.

BARK AND WOOD BORER.

Infests Yellow Locust twigs on dead tree.

Adults bred April 24 Collected June 10.
Monongalia county.

161. **Liopus punctatus**, Lec.

WOOD BORER.

Infests dying and dead Plum and Dogwood.

Adults bred May 11, 20. Pupæ April 25; May 4.
Wood county,

162. **Lepturges signatus**, Lec.

BARK AND WOOD BORER.

Infests dead Beech branches.

Adults bred May. Larvæ April 12.
Monongalia county.

163. **Hyperplatys aspersus**, Say.

BARK AND WOOD BORER.

Infests dying and dead Sumach, Hackberry and White Walnut.

Adults bred April 23 ; May 2.
Wood county.

164. **Hyperplatys masculatus**, Hald

Collected on dead Maple and Yellow Locust branches.

Adults May 26 ; June 13.
Monongalia county.

165. **Urographis fasciatus**. **De G.**

BARK BORER.

Infests dying and dead Chestnut. Black Oak.

Adults June 11 ; July 24. Pupæ Sept. 12
Wood and Monongalia counties.

166. **Graphi surus pusillus**, Kirby.

Infests bark on dead Black Spruce.

Adults August 29 ; Sept. 2.
Randolph county.

167. **Ancanthocinus obsoletus**, Oliv.

Collected on Spruce stump. Bred from Pine bark

Adults collected July 9. Larvæ Nov 7.
Grant county.

168. **Hoplosia nubila**, Lec.

BARK BORER.

Infests bark on dead White Elm.

Adult May 15.
Wood county.

169. **Pogonocherus penicellatus**, Lec

WOOD BORER.

Infests sap wood of dying and dead Sumach.

Adult July 16.
Hancock county.

170. **Eupogonius vestitus**, Say

BARK AND TWIG BORER.

Infests White Walnut twigs.

Adults bred May 30.
Monongalia county.

171. **Oncideres cingulata**, Say

THE HICKORY TWIG GIRDLER.

Girdles the twigs and small branches on living trees. Larvæ develops in dead portion Infests Hickory, Basswood.

Adults July 22; October 29. Larvæ April 12.
Marion, Wood and Mason counties

172 **Saperda discoides**, Fab.

BARK BORER.

Infests bark on dead and dying Hickory.

Adults bred May 12 and 30. Pupæ April 30
Wood and Monongalia counties.

173. **Oberea tripunctata**, Swed.
var. Myops, Hald.
Adult collected flying July 15, 20.
Randolph and Webster counties.

174. **Oberea ruficollis**, Fab.
Adult collected on Blackberry fruit July 25.
Wood county.

175. **Cerambycid, sp. a.**

BARK AND WOOD BORER

Infests bark and wood of dying Red Cedar.

Adults bred May 8
Hampshire county.

Order COLEOPTERA; Family CHRYSOMELIDÆ.

176 **Anomoæ laticlavia**, Forst

FOLIAGE FEEDER.

Collected on Yellow Locust leaves. Common also on Sumach leaves.

Adults June 10, 17; July 5.
Monongalia, Wood and Gilmer counties.

177 **Chlamys plicata**, Fab

FOLIAGE FEEDER.

Larvae and adults frequent on Sycamore leaves.

Adults April 17; May 11. Bred August 20. Larvae August 2.
Wood and Kanawha counties.

178 **Cryptocephalus mammifer**;*

FOLIAGE FEEDER.

Common on Yellow Locust leaves. Also collected on Blackberry and Raspbery leaves.

Adults May 20, 21, 30; June 1, 13.
Monongalia and Wood counties.

179. **Pachybrachys atomarius**, Melsh.

FOLIAGE FEEDER.

Frequent on Yellow Locust leaves.

Adults June 16, 23, 26; July 16.
Wood, Upshur and Hancock counties.

180. **Glyptoscelis pubescens**, Fab.

Collected on Pine leaves.

Adults May 2.
Wood county.

181. **Myochrous denticollis**, Say.

Collected on Yellow Locust leaves

Adult April 19; May 5.
Wood county.

182 **Paria aterroima**, Oliv.

FOLIAGE FEEDER

Collected on Yellow Locust leaves. Common.

Adults May 18; June 10.
Wood county.

183. **Colaspis brunnea**, Fab.

FOLIAGE FEEDER.

Collected on Yellow Locust leaves June 27. Common on Grape leaves. Doing considerable damage.

Adults June 25, 27; July 16, 22.
Monongalia, Wood, Tyler and Hancock counties.

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*Determined by Dr. Horn.

184. **Colaspis tristis**, Oliv.

Collected on Yellow Locust and Blackberry leaves.

Adults June 16, 17; Aug. 24.
Wood county.

185. **Colaspis puncticollis**, Say.

Collected on Yellow Locust and Sumach leaves.

Adult June 1, 13; July 3, 30.
Wood, Wayne Monongalia and Wirt counties.

186 **Doryphora clivicollis**, Kirby.

Collected on Yellow Locust leaves.

Adults June 21.
Mono gal a and Wood counties.

187 **Chrysomela saturalis**, Fab.

FOLIAGE FEEDER.

Collected on Yellow Locust leaves.

Adults April 5, 16, 17; Aug. 8.
Monongalia and Wood counties.

188. **Chrysomela scalaris**, Lec.

Collected on Mountain Ash leaf.

Adults June 23.
Randolph county.

189 **Chrysomela bigsbyana**, Kirby.

FOLIAGE FEEDER.

Common on Willow leaves.

Adults July 16, 30.
Wood and Upshur counties

190. **Gastroidea cyanea**, Melsh.

FOLIAGE FEEDER.

Collected on Willow leaves.

Adult May and June.
Wood county.

191. **Lina lapponica**, Linn.

FOLIAGE FEEDER.

Common on Willow leaves.

Adults April 12, 17, 29; May 2, 4; June 16. Eggs May.
Wood and Upshur counties.

192. **Phyllodecta vulgatissima**, Linn.

FOLIAGE FEEDER.

Very common on Black Willow leaves; eating surface of leaves

Adults, Larvæ and Pupæ June 16; Aug 27
Randolph county.

193. **Cerotoma caminea**, Fab.

Collected feeding on sap flowing from wounds in green bark made by *Cyllena robiniæ* larvæ on Yellow Locust.

Adults May 1; June
Wood county.

194. **Phyllechthrus gentilis**, Lec.

FOLIAGE FEEDER.

Very common on Yellow Locust leaves.

Adults May 21, 30; June 1, 12, 13.
Monongalia and Wood counties.

195. **Adimonia cavicollis**, Lec.

FOLIAGE FEEDER.

Common on Wild Red Cherry leaves. Defoliating trees.

Adults common July 10.
Tucker county.

196. **Blepharida rhois**, Forst.

FOLIAGE FEEDER.

Collected on Sumach.

Adults April 11, 18.
Wood county.

197. **Crepidodera rufipes**, Linn.

FOLIAGE FEEDER.

Common on Yellow Locust leaves.

Adults April 30; May 11, 18, 21, 24, 30; June 13, 16.
Wood, Upshur, Monongalia and Tucker counties.

198. **Crepidodera Helxines**, Linn.

FOLIAGE FEEDER.

Common on Willow and Wild Red Cherry leaves.

Adults May 23; July 10.
Wood and Tucker counties.

199. **Orthaltica copalina**, Fab.

FOLIAGE FEEDER

Common on Sumach eaves Collected on Yellow Locust leaves.

Adults June 10; July 14.
Monongalia and Randolph counties.

200. **Odontota dorsalis**, Thumb.

ADULT FOLIAGE FEEDER.
LARVÆ LEAF MINER.

Causes Yellow Locust leaves to turn brown as if scorched by fire Beetles feed on surface of leaves. Larvæ mine beneath surface of leaves and form blisters. Adults also observed feeding on Beech, Apple, Wild Cherry and Wisteria leaves. Very common.

Adults May 11, 18, 30; June 10, 12, 15, 16, 21, 22, 26, 27, 29; July 16, 20; Aug. 16; Sept. 14, 17; Oct 3. Pupæ June 26; July 6, 18. Larvæ June 4, 13, 29; July 4, 6; Aug. 8.
Monongalia, Wood, Hancock, Harrison, Upshur, Tyler, Preston and Tucker counties.

201. **Odontota nervosa**, Panz.

FOLIAGE FEEDER

Very common on Yellow Locust leaves; also feeds on Apple leaves.

Adults April 30; May 18, 21, 30; June 10, 13, 26, 27; July 16.
Monongalia, Wood, Hancock and Jackson counties.

202. **Coptocycla guttata**, Oliv.

Collected on Yellow Locust leaves.

Adults May 18.
Wood county.

Order COLEOPTERA; Family TENEBRIONIDÆ

203. **Centronopus calcaratus**,*

Collected on Hemlock log.

Adults June 16.
Upshur county.

204. **Hypophloeus cavus**, Lec.

With *Xyleborus celsus* in Hickory.

Adult July 22.
Tyler county.

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*Determined by Dr. Riley.

205. **Hypophloeus parallelus**, Melsh.

With *Polygraphus rufipennis* in Spruce bark; *Tomicus cacographus; Tomicus pini; Dendroctonus frontalis; Crypturgus pusilus* in Pine bark and *Chramesus icoriae* in Hickory bark.

Adults March 26; May 5, 18; June 24, 25, 29; July 8, 13, 14, 20, 24; Aug.; Nov. 7 Larvæ Aug. 12; Oct. 12.

Grant, Hampshire, Wood, Hardy, Monongalia, Pendleton, Randolph, Marshall and Tucker counties.

206. **Hypophloeus thoracicus**, Melsh.

With *Polygraphus rufipennis* in Spruce bark.

Adult Aug. 29.
Randolph county.

207. **Hypophloeus bicolor**, Melsh

With *Xyleborus pubescents* in Chestnut wood and *Xyleborus fuscatus* in Black Oak wood.

Adult May 20; July 30.
Wood county.

208. **Hypophloeus sp. a.**

With *Xyleborus sp. a.* in Chestnut Oak wood.

Adult July 30.
Wood county.

209. **Tenebrionid larvæ.**

With *Polygraphus rufipennis* in Spruce bark.

Larvæ August 30.
Randolph county.

Order COLEOPTERA; Family MELANDRYIDÆ

210. **Xylita lævigata,** Hellw.

WOOD BORER.

In sap-wood of dead spruce

Adults March 29.
Tucker county.

211. **Serropalpus barbatus**, Schall.
Adult collected on Black Spruce stump July 10
Tucker county.

Order COLEOPTERA; Family PYTHIDÆ.

212. **Pytho niger**, Kirby.

BARK BORER.

Infests bark on dying and dead White Pine and Black Spruce

Adults in chip cocoons April 1; May 9.
Marion and Grant counties.

213. **Pytho americanus**, Kirby.

BARK BORER

Infests dying and dead bark on Pine logs and stumps. Common.

Adults February 20.
Wood county.

Order COLEOPTERA; Family MORDELLIDÆ.

214. **Tomaxia bidentata,** Say.

Collected on bark of dying Hickory tree.

Adult June 29.
Wood county.

Order COLEOPTERA; Family ATTLEABIDÆ.

215. **Attelabus nigripes,** Lec.

Collected on Sumach and Yellow Locust leaves.

Adults June 23, 27; July 3; August 16.
Wood, Wirt and Monongalia counties.

216. **Sitones flavescens,** Marsh.

On Locust leaves.

Adults June 27.
Wood county.

Order COLEOPTERA; Family CURCULIONIDÆ.

217. **Apion nigrum,** Hbst.

FOLIAGE FEEDER.

Very common, feeding on tender Yellow Locust leaves.

Adults May 18, 21, 25, 30; June 10. 12, 13, 16, 24, 27; July 16, 22, 30; September 10
Wood, Monongalia, Hancock, Jackson, Tyler and Wayne counties.

218 **Listronotus latiusculus**, Boh.

Under Red Cedar bark.

Adults March 10; April 17; May 21.
Wood county.

219. **Pissodes strobi**, Peck.

TWIG AND BARK BORER.
WHITE PINE WEEVIL.

Attacks the terminal twigs on small living trees, causing dwarfed and deformed trees, also infests bark on logs, and trunks of living and dying Pine and Spruce.

Adults June 27; July 8, 14, 24; Aug. 4; Oct 25. Pupæ June 23, 29; July 8, 13; Larvæ June 29; July 8, 11; Oct. 25; Nov. 30.
Randolph, Grant, Pendleton, Pocahontas, Hardy, Monongalia, Wood, Grant, Mineral and Hampshire counties.

220 **Hylobius abietes.***

BARK BORER.

Collected on dying Pines.

Adults April 19; May 18; July 14.
Wood, Hampshire and Monongalia counties.

221 **Otidocephalus chervolatii**, Horn.

Collected on Yellow Locust leaves.

Adult July 16
Hancock county.

222. **Magdalis olyra**, Hbst.

BARK BORER.

Common under and in bark on dead Hickory.

Adults bred April 14; May 12, 15. Pupæ April 23.
Wood county.

223 **Magdalis inconspicua**, Horn.

TWIG BORER.

Infests dead twigs on Black Walnut.

Adults May 13.
Wood county.

BARK BORER

Infests twigs on dead Hickory.

Adults bred Oct. 15.
Marion county.

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*Determined by Dr. C. V. Riley.

224. **Anthonomus nebulosus**, Lec.

FRUIT WEEVIL

Infests Thorn fruits.

Adults June 16.
Preston county.

225. **Orchestes niger**, Horn.

Collected on Willow leaves.

Adults July 30.
Wayne county.

226. **Orchestes ephippiatus**, Say.

Collected on Willow leaves.

Adult July 30
Wayne county.

227. **Gymnetron teter**, Fab.

Collected on Yellow Locust leaves.

Adults June 24.
Wood and Harrison counties.

228. **Cryptorhynchus obliquus**, Say.

SUMACH ROOT BORER.

Infests base and roots of Sumach. Causes the death of the shrub Beneficial where Sumach "sprouts" are a pest.

Adults bred Jan. 2; July 13. Larvæ July 29; Oct. 15.
Marion and Wood counties.

229. **Cryptorhynchus ferratus**, Say.

BARK BORER.

Infests bark on dead Sassafras.

Adults June 27. Pupæ June 27. Larvæ June 27.
Wood county.

230 **Copturus binotatus**, Lec.

BARK BORER.

Infests bark on dying Sumach. Common.

Adults July 16; October.
Hancock, Marion and Monongalia counties.

231. **Balaninus caryatrypes**, Boh.

CHESTNUT NUT WEEVIL.

Common in Chestnuts.

Larvæ November 13.
Monongalia county.

Order COLEOPTERA; Family BRENTHIDÆ.

232. **Eupsalis minuta,** Drury.

BARK BORER.

Adults collected under loose bark on dead Black Oak, Beech, Elm.

Adults April; July 16, 22.
Wood, Hancock and Tyler counties.

Order COLEOPTERA; Family CALANDRIDÆ.

233. **Himatium conicum,** Lec.

BARK BORER.

Common in bark on logs and dead trees.

Adults March 26, 28; April 17; May 4; September 1.
Randolph, Tucker, Wood and Pendleton counties

234. **Cossonus platalea,** Say.

Under dead bark on White Walnut log.

Adults (dead) April 12.
Monongalia county.

235. **Cossonus corticola,** Say

Very common under dead bark on Pine and Spruce trees.

Adults April 1; June 24; July 13, 20, 24, 27; Aug. 12, Oct. 10.
Monongalia, Marion, Marshall, Wood and Hampshire counties.

Order COLYOPTERA; Family SCOLYTIDÆ.*

236. **Platypus quadridentatus,** Oliv

TIMBER BEETLE.

Infests Black Oak and Chestnut.

237. **Platypus compositus,** Say.

TIMBER BEETLE.

Infests Black Oak, Sugar Maple, Chestnut, Basswood, Magnolia, Red Elm, Beech and Wild Cherry.

238. **Corthylus punctatissimus,** Zimm.

TIMBER BEETLE.

Infests Sassafras.

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*For further notes on species mentioned in this family—See Catalogue of West Va. Scolytidæ and their enemies, 1893.

239. **Monarthrum fasciatum**, Say.

TIMBER BEETLE.

Infests Pine, White Oak, Black Oak, Basswood, Beech and Hemlock.

240. **Monarthrum mali**, Fitch.

TIMBER BEETLE.

Infests Pine, White Oak, Black Oak, Red Oak, Jack Oak, Elm, Beech, Maple, Chestnut, Basswood, Honey Locust, Yellow Poplar (Tulip), Buckeye, Morello Cherry, Red Cedar and Hemlock.

241. **Gnathotrichus retusus**, Lec.

TIMBER BEETLE.

Infests White Pines; also other Pines.

242. **Gnathotrichus materiarius**, Fitch.

TIMBER BEETLE.

Infests Pines.

243. **Pityophthorus minutissimus**, Zimm.

BARK BEETLE.

Infests Black Oak, White Oak, Jack Oak, Chestnut Oak, Dogwood.

244. **Pityophthorus, sp. a.**

BARK BETTLE.

Infests White Pine; also other Pine.

245. **Pityophthorus pullus**, Zimm.

BARK BEETLE.

Infests Pines.

246. **Pityophthorus sp. b.**

BARK BEETLE.

Collected on bark of dead Maple.

247. **Pityophthorus plagiatus**, Lec.
Tomicus plagiatus, Lec.

BARK BETTLE.

Infests Pines.

248. **Pityophthorus sparsus**, Lec.

BARK BETTLE.

Infests White Pines; also other Pines.

249 **Pityophthorus cariniceps**, Lec.

TWIG BEETLE.

Infests Black Spruce.

250. **Pityophthorus confinis**, Lec.

BARK BEETLE.

Infests Pines.

251. **Pityophthorus consimilis**, Lec.

BARK BEETLE.

Infests Sumach and all of the species of the genus Rhus.

252. **Pityophthorus hirticeps**, Lec.

TWIG BEETLE.

Infests Black Spruce.

253. **Pityophthorus sp c.**

BARK BEETLE

Infests Black Spruce.

254. **Pityophthorus lautus**, Eich.

BARK BEETLE

Infests Pine.

255. **Pityophthorus puberulus**, Lec.

BARK BEETLE.

Infests Pine.

256. **Pityophthorus sp. d.**

TWIG BEETLE.

Infests Pines.

257. **Pityophthorus sp. e.**

TWIG BEETLE

Infests Pine.

258. **Pityophthorus tuburculatus**, Eich

BARK BEETLE.

Infests Black Spruce.

259. **Pityophthorus sp. f.**

TWIG BEETLE.

Infests Pine Twigs.

260. **Pityophthorus sp. g**

BARK BETTLE.

Infests White Pine; also other Pines

261. **Hypothenemus sp b.**

TWIG BEETLE.

Infests White and Black Walnut

262. **Hypothenemus sp. d.**

TWIG BETTLE.

Infests Pine (P inops.)

263 **Hypothenemus dissimilis**, Zimm.

TWIG BETTLE.

Infests Hickory.

264. **Hypothenemus sp. e.**

TWIG BETTLE.

Infests Hickory.

265. **Hypothenemus sp. f.**

TWIG BEETLE.

Infests Oak.

266. **Hypothenemus sp. g.**

TWIG BEETLE.

Infests White Oak.

267. **Xyloterus retusus**, Lec

TIMBER BETTLE.

Infests Large Aspen.

268. **Xyloterus bivittatus**, Kirby.

TIMBER BEETLE.

Infests Black Spruce, Hemlock.

269. **Xyloterus scabricollis**, Lec.

TIMBER BEETLE.

Infests Pine.

270. **Xyloterus politus**, Say.
Xyloterus unicolor, Eich.

TIMBER BEETLE.

Infests Beech, Black Oak, White Oak, Red Oak, Hemlock, Sugar Maple, Red Maple, Chestnut, Magnolia, Elm, Hickory, Ash, White Birch, Black Spruce.

271. **Xyleborus pyri**, Peck.

TIMBER BEETLE.

Infests Hemlock, Beech, Birch and Red Oak.

272. **Xyleborus, sp. a.**

TIMBER BEETLE.
Infests Cedar.

273. **Xyleborus obesus**, Lec.

TIMBER BEETLE.
Infests Black Oak, Beech and Hemlock.

274. **Xyleborus celsus**, Eich.

TIMBER BEETLE.
Infests Hickory.

275. **Xyleborus fuscatus**, Eich.

TIMBER BEETLE.
Infests Black Oak and Hichory.

276. **Xyleborus sp. b.**

TIMBER BEETLE.
Infests White Oak, Chestnut Oak, Black Oak, Jack Oak.

277. **Xyleborus, sp. c.**

TIMBER BEETLE.
Infests Jack Oak.

278. **Xyleborus, sp. d.**

TIMBER BEETLE
Infests Black Oak, Hickory and Chestnut.

279. **Xyleborus pubescens**, Zimm.

TIMBER BEETLE.
Infests White Oak, Chestnut, Black Oak, Buckeye, Magnolia, Basswood, Cultivated Cherry, Honey Locust, Jack Oak.

280. **Xyleborus, sp. f.**

TIMBER BEETLE.
Infests Pine.

281 **Dryocoetes autographus**, Ratz.
(*Dryocoetes septentrionis*, Mann.)

BARK BEETLE
Infests Black Spruce, Norway Spruce

282. Dryocoetes, n. sp

BARK BEETLE.

Infests Birch (White), and Red Wild Cherry.

283. **Dryocoetes affaber?**, Mann.

BARK BEETLE.

Infests Black Spruce.

284. **Dryocoetes granicollis**, Lec.

BARK BEETLE.

Infests Black Spruce.

285. Tomicus calligraphus, Germ.

BARK BEETLE.

Infests all of the Pines.

286. Tomicus cacographus, Lec.

BARK BEETLE.

Infests all of the Pines, Black Spruce, Norway Spruce

287. Tomicus pini, Say.

BARK BEETLE.

Infests all of the Pines, Norway Spruce.

288. **Tomicus avulsus**, Eich.

BARK BEETLE.

Infests White and other Pines.

289. **Tomicus cælatus**, Eich

BARK BEETLE.

Infests all of the Pines, Black Spruce Norway Spruce.

290. Scolytus quadrispinosus, Say.

HICKORY BARK BEETLE.

Infests Hickory.

291. Scolytus muticus, Say

BARK BEETLE.

Infests Hackberry.

292. Chramesus icoriæ, Lec.

BARK BEELE.

Infests Hickory.

293. Polygraphus rufipennis, Kirby.

SPRUCE BARK BEETLE.

Infests Black Spruce.

294. **Phlœotribus liminaris**, Harr.

BARK BEETLE.

Infests Peach, cultivated Cherry, Wild Cherry.

295. **Phlœtribus sp. b**

BARK BEETLE.

Infests Red Cedar.

296. **Phlœotribus frontalis**, Oliv.

BARK BEETLE.

Infests Mulberry.

297. **Hylesinus aculeatus**, Say.

ASH BARK BEETLE.

Infests Black Ash.

298. **Hylesinus opaculus**, Lec.

ELM BARK BEETLE.

Infests Elm.

299. **Phloeosinus dentatus**, Say.

CEDAR BARK BEETLE.

Infests Red Cedar.

300. **Dendroctonus terebrans**, Oliv.

BARK BEETLE.

Infests all of the Pines.

301. **Dendroctonus frontalis**. Zimm.

Infests all of the Pines, Black Spruce, Norway Spruce.

302. **Crypturgus pusillus**, Gyll.
Crypturgus atomis, Lec.

BARK BEETLE.

Infests Pines, Black Spruce, Norway Spruce.

303. **Hylastes sp.**

BARK BEEETLE.

Infests Pines.

304. **Hylurgops glabratus**, Zett.
(*Hylurgops pinifex*, Fitch.)

BARK BEETLE.

Infests the Pines.

Order COLEOPTERA; Family ANTHRIBIDÆ.

305. **Eusphyrus Walshii,** Lec.

Infests dead branches on Yellow Locust.

Adults bred April 24.
Monongalia county.

306. **Cratoparis lunatus,** Fab.

Common on fungus on and under bark of dead trees.

Adults Feb.; April 13, 17; May 9.
Wood county.

Order HYMENOPTERA; Family TENTHREDINIDÆ.

307. **Nematus robiniæ,** Forbes

FOLIAGE FEEDER

Feeding on leaves. Infests Yellow Locust.

Larvæ May 18, 21.
Wood and Jackson counties.

308. **Nematus sp. a.**

FOLIAGE FEEDER.

Feeding on leaves. Infests Yellow Locust.

Larvæ May 30.
Monongalia county.

309. **Nematus sp. b.**

FOLIAGE FEEDER.

Feeding on leaves common. Infests Dogwood.

Larvæ July 12.
Randolph county.

310. **Lophyrus pinus rigida,** Nort.

FOLIAGE FEEDER

Feeding on leaves. Infests *pinus rigida.*

Larvæ May 20.
Wood county.

Order HYMENOPTERA; Family UROCERIDÆ.

311. **Xiphydria albicornis**, Harris.

WOOD BORER.

Females taken ovipositing in bark of dead Maple.

Adults June 2; July 7.
Monongalia county.

312 **Urocerus abdominalis**, Harris.

WOOD BORER.

Grub enters sap and heartwood of dying trees. Infests Pine, Spruce.

Adults July 25; Aug. 30.
Randolph county.

313. **Urocerus albicornis**, Fabr.

WOOD BORER.

Larvæ enters green sap and heart wood of injured and dying trees. Infests Hemlock.

Adult July 17.
Monongalia county.

314. **Urocerus cyaneus**, Fabr.

WOOD BORER.

Larvæ bore in green and dead wood of logs and dying trees. Infests Black Spruce.

Aug. 29; Sept. 1.
Randolph county.

315. **Urocerus sp. a**

WOOD BORER.

Flying in Spruce forest.

Adult Sept. 1.
Randolph county.

316. **Uroerus sp. b.**

Ovipositing in bark on living Yel low Pine.

Adults Oct. 21.
Mononongalia county.

317. **Tremex columba**, Linn.

WOOD BORER.

Larvæ bores in green wood of diseased and dying trees. Hastens death of trees Infests Maple, Beech.

Adults Aug. 20; July 16; Oct. 21.
Monongalia county.

Order HYMENOPTERA; Family CYNIPIDÆ.

318. **Callirhytes pattoni,** Bass.

GALL FLY.

Causes wooly galls on White Oak twigs.

Adults bred. Galls collected March 16.
Preston county.

319. **Neuroterus noxiosus**, Bass.

GALL FLY.

Causes galls on Oak twigs.

Adults April 1. Larvæ Feb. 20.
Wood county.

320. **Neuroterus**, **sp**.

GALL FLY.

Causes galls on Oak twigs.

Adults February 24. Larvæ December 24.
Wood county.

321. **Ceroptres**, **sp.**

GALL FLY.

Causes galls on Oak twigs.

Adults February 20.
Wood county.

322. **Synergus lignicola**, O. S.

GALL FLY.

Causes large woody galls on Scarlet Oak twi s and branches.

Adults. Larvæ April 12
Upshur county.

Order HYMENOPTERA; Family EVANIIDÆ

323. **Aulacus abdominalis**, Cress

BARK BORER.

Bred from Hemlock bark. Infested by *Melanophila fulvaguttata*.

Adults July 24. Bred Adults April 13; May 15; June 15.
Grant and Monongalia counties.

Order HYMENOPTERA; Family ICHNEUMONIDÆ.

324. **Adelognathus briviceps**, Ashm. n. sp

PRIMARY PARASITE.

Bred from Saw Fly larvæ. *Nematus sp. a.* on Yellow Locust leaf.

Adults May 30.
Monongalia county.

325. **Rhyssa albomaculata,** Cress.

PRIMARY PARASITE.

Emerging from dead Spruce tree infested by *Unocerus cyaneus*.

Adults July 9; Sept. 1.
Randolph and Wood counties.

326. **Thalessa atrata**, Fabr.

PRIMARY PARASITE.

Females taken with ovipositors inserted in wood infested by *Tremex columba* in dying Beech.

Adults June 20; July 14, 29. Pupæ Feb. 15. Larvæ Oct. 21.
Webster, Tucker and Wood counties.

327. **Thalessa lunator**, Fabr.

PRIMARY PARASITE.

Females taken with ovipositor inserted in wood infested by *Tremex columba* larvæ.

Adults March 1; July 29. Pupæ Feb. 15. Larvæ Oct. 21.
Wood county.

328. **Thalessa nortoni**, Cress.

Female taken with ovipositor inserted in Spruce log. No trace of larvæ of any kind could be found in the wood of the log.

Adult July 7.
Grant county.

329. **Ephialtes gigas,** Walsh.

Collected on bark of dead Hickory and Chestnut infested by *Longicorn* and *Buprestid* larvæ.

330. **Pimpla conquisitor**, Say.

PRIMARY PARASITE.

Attacks Lepidopterous larvæ on Buckeye leaves.

Adults bred June 15.
Monongalia county.

331. **Pimpla inquisitor**, Say.

PRIMARY PARASITE.

Attacks *Orgyia leucostigma* on Maple.

Adults bred Jan. 1; Feb. 24; Oct. 2; Nov 13.
Monongalia county.

332. **Glypta leucozonata**, Ashm.

PRIMARY PARASITE.

Attacks Lepidopterous larvæ on Sumach leaves.

Adults bred Oct. 24.
Monongalia county.

333. **Euxorides americanus**, Cress.

Collected on bark on dying Pine tree infested by Scolytid and Cerambycid larvæ.

Adults June 23.
Pendleton county.

334 **Xylonomus albopictus**, Cress.

PRIMARY PARASITE.

Attacks Buprestid larvæ and Agrilus larvæ in Beech bark.

Adults bred July 7, 27.
Tucker and Wood counties.

335. **Xylonomus insularis**, Cress.

Collected on Hemlock bark infested by *Melanophila fulvoguttata*.

Adults July 12.
Grant county.

Order HYMENOPTERA; Family BRACONIDÆ.

336 **Bracon aguili**, Ashm.

PRIMARY PARASITE.

Attacks *Neoclytus erythrocephalus* larvae in Hickory and Cerambycid larvae in Apple and Sassafras.

Adults May 8, 18; July 20; Sept. 14. Bred Pupae and cocoons April 15, 25. Adults emerged May 8, 18.
Monongalia and Wood counties.

337. **Bracon eurygaster**, Brulli.

PRIMARY PARASITE.

Attacks Cerambycid larvæ in Elm.

August 4.
Kanawha county.

338. **Bracon mavoritus**, Cress.

PRIMARY PARASITE.

Attacks *Tetropium cinnamopterum* in Spruce wood.

Adults bred Feb. 24; April 20; July 8. Larvæ Dec. 24.
Monongalia county.

339. **Bracon pectinator**, Say.

PRIMARY PARASITE.

Attacks *Melanophila fulvoguttata* larvæ in Hemlock, *Chrysobothris femorata* in Oak and Cerambycid larvæ in Black Spruce and Elm.

Adults bred March 30; April 20; July 12; Aug. 6. Larvæ March 30, 31 Cocoons April 9; July 24.
Grant, Wood and Tucker counties.

340. **Bracon pirsodis**, Ashm.

PRIMARY PARASITE.

Attacks *Dendroctonus frontalis* in Pine Bark. No. 82 Catalogue W. Va. Scolytidae, 1893.

341. **Bracon simplex**, Cress.

PRIMARY PARASITE.

Attacks Buprestid and Cerambycid larvae in Beech and Spruce bark.

Adults Aug. 29 to Sept. 1; July 7.
Randolph and Grant counties.

342. **Bracon sp. a.** Larva.

PRIMARY PARASITE.

Attacks *Asemum moestum* larvæ in Black Spruce bark.

Larvae July 7.
Grant county.

343. **Bracon sp. b.** Larva.

PRIMARY PARASITE.

Attacks *Melanophila fulvoguttata* in Hemlock bark.

Larva March 29.
Tucker county.

344. **Phanomeris sp**.

PRIMARY PARASITE

Attacks Lepidopterous leaf roller larva on locust leaves.

Adult bred from cocoon Aug. 8
Monongalia county.

345. **Rhysipolis biformis**, Ashm.

PRIMARY PARASITE.

Attacks Cerambycid and Buprestid larvæ in bark of Spruce.

Adults March 31. Bred cocoons Sept. 1. Adults Sept. 14.
Monongalia and Grant counties.

346. **Rhyssalus pityophthori**, Ashm.

With Pityophthorus sp d. in Pine bark. No. 83 Catalogue W. Va. Scolytidæ 1893.

347. **Spathius brachyrus**, Ashm.

PRIMARY PARASITE.

Attacks *Pissodes strobi* in Pine and *Dryocoetes autographus* in Spruce.

Bred Adults Sept. 28; Nov. 10. Cocoons March 15. Adults emerged April 6.

Wood and Monongalia counties.

348. **Spathius brunneus**, Ashm.

PRIMARY PARASITE.

Attacks *Scolytus muticus* in Hackberry bark. No 91, Catalogue W. Va. Scolytidæ 1893.

349. **Spathius claripennis**, Ashm.

PRIMARY PARASITE.

Attacks *Polygraphus rufipennis* in Spruce bark. No 84, Cat. W. Va. Scolytidæ 1893.

350. **Spathius canadensis**, Ashm.

PRIMARY PARASITE.

With *Phloeosinus dentatus*, in Red Cedar; *Tomicus cacographus* in White Pine and *Agrilus otiosus* in Hickory bark.

Adults March 31; April 14, 18, 23, 29; May 10.

Wood county.

351. **Spathius pollidus,** Ashm.

PRIMARY PARASITE

Attacks *Tomicus cacographus* in Pine bark. No. 89 in Catalogue West Virginia Scolytidæ 1893

352. **Spathius simillimus**, Ashm.

PRIMARY PARASITE.

Attacks Buprestid larvae and *Chrysobothris pusilla* in Spruce. *Cryptorhynchus ferratus* in Sassafras, *Agrilus bilineatus* in Oak.

Cocoons March 26, 29, 31; May 2, 4. Adults May 1, 18, 25; April 25.

Grant, Tucker and Wood counties.

353. **Spathius tomici**, Ashm.

PRIMARY PARASITE.

Attacks *Dryocoetes autographus* in Spruce No. 90 in Catalogue West Va. Scolytidae 1893.

354. **Spathius unifasciatus**. Ashm.

PRIMARY PARASITE.

Attacks *Scolytus quadrispinosus* in Hickory bark. No. 85 Catalogue W. Va. Scolytidae

355 **Spathius. sp.**

PRIMARY PARASITE.

Attacks Buprestid larvae in Elm bark.

Bred cocoons April 13. Adult April 14
Wood county.

356. **Lysitermus scolyticida**, Ashm.

Attacks *Scolytus 4-spinosus* in Hickory bark. No 92 Catalogue West Va Scolytidae, 1893.

357. **Lysitermus** (?) **sp.**

Attacks *Tomicus Plagiatus* in Pine bark. No. 93 Catalogue West Va. Scolytidae, 1893

358 **Cænophanes anthaxia**, Ashm.

PRIMARY PARASITE.

Attacks *Anthaxia virdicornis* in Willow bark; Agrilus larvæ in Dogwood and Copturus binotatus in Sumach.

Bred cocoons April 14; May 4. Adults emerged May 24, 26.
Cocoons collected June 15. Adults bred Nov. 8.
Wood and Marion counties.

359. **Cænophanes pityophthori**, Ashm.

PRIMARY PARASITE.

Attacks *Pityophthorus sp. c.* and *Polygraphus rufipennis* in Spruce bark. No. 94. Catalogue West Va. Scolytidæ 1893.

360. **Cænophanes hylotrupidis,** Ashm.*

PRIMARY PARASITE.

Attacks Cerambycid larvæ in Cedar bark.

Bred adult April 4.
Wood county.

361. **Cænophanes sp.**

PRIMARY PARASITE.

Attacks *Agrilus egenus* in Yellow Locust bark.

Adults April 25. Cocoons March 16.
Monongalia county.

362. **Pambolus bifasciatus,** Asm. (n. sp.)†

PRIMARY PARASITE.

Attacks *Anthaxia virdicornis* in Willow bark.

Adults May 4; June 24.
Wood county.

363. **Doryctes erythromelas,** Brulle.

PRIMARY PARASITE.

Attacks Wood-boring larvae. Kind of wood not noted.

Bred Adult April 3.
Wood county.

364. **Rhogas intermedius,** Cress.

PRIMARY PARASITE.

Attacks *Acronycta americana* on Maple.

Bred Adults Oct. 5. Collected Sept.
Monongalia county.

365. **Apanteles sp.**

PRIMARY PARASITE.

Attacks *Orgyia leucostigma.*

Adults bred in October.
Monongalia county.

366. **Microdus laticinctus,** Cress.

PARASITE.

Collected on Locust leaves infested by Lepidopterous and other larvae.

Adults May 20; July 16.
Wood county.

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*Described by Wm. H. Ashmead in Canadian Entomologist Vol. XXV., Page 78.
†Described by Wm. H. Ashmead in Psyche Vol. VI. Page 289.

367. **Perilitus gastrophysae**, Ashm.

PARASITE.

Collected on locust leaves infested with Lepidopterous, Coleopterous and other larvae.

Adult June 16.
Upshur county.

368. **Blacus longicandus**, Prov.

PRIMARY PARASITE.

Attacks *Lyctus striatus* in dry Yellow Locust wood.

Adults June 23.
Pocahontas county.

369. **Helcon legator**, Say.

PRIMARY PARASITE.

With Scolytus Muticus and Agrilus larvæ in Hackberry bark.

Cocoons May 2. Adults bred.
Wood county.

370. **Helcon occidentalis**, Ashm (n. sp)*

PRIMARY PARASITE.

Attacks *Tetropium cinnamopterum* in Black Spruce wood.

Bred Cocoon July 8. Adult emerged July 14.
Grant county.

371. **Promachus rubiceps**, Ashm.

PRIMARY PARASITE.

With *Neoclytus erythrocephalus* and *Agrilus egenus* in Locust twigs.

Adults April 24.
Monongalia county.

372. **Diaspasta (Alysia) nibicunda**, Say.

PARASITE

Collected on Locust leaves infested by Lepidopterous and other insects.

Adults September 14; June 27.
Monongalia county.

373. **Cosmophorus Hopkinsii sp. n.**, Ashm. MS.

Attacks *Polygraphus rufipennis* in Spruce bark. No 96 Catalogue W. Va. Scolytidæ, 1893.

*Described by Wm. H. Ashmead Canadian Entomologist, Vol. XXV., p. 78.

Order HYMENOPTERA; Family CHALCIDIÆ.

374. **Simcra canadensis**, Cress.

PRIMARY PARASITE.

Attacks *Magdalis olyra* in Hickory bark.

Bred—Larvae April 23. Adults emerged May 5.
Wood county.

375. **Perilampus hyalinus** Say.

PRIMARY PARASITE.

Attacks *Lyctus Striatus* in dry Yellow Locust wood.

Adults June 23.
Pocahontas county.

376. **Eurytoma auriceps**, Walsh.

PRIMARY PARASITE.

Attacks gall insect on oak.

Adults March 16.
Marion county.

377. **Eurytoma sp. d**

PRIMARY PARASITE.

Attacks *Tomicus plagiatus* in Pine bark. No. 101 Catalogue West Va. Scolytidæ 1893.

378 **Eurytoma sp. e.**

PRIMARY PARASITE

Attacks *Phloesinus dentatus* in Red Cedar bark. No 102 Catalogue West Va. Scolytidae 1893

379. **Eurytoma sp. f.**

PRIMARY PARASITE.

Attacks *Polygraphus rufipennis* in Black Spruce bark. No. 103 Catalogue W. Va. Scolytidae 1893.

380. **Eurytoma sp. g.**

With *Agrilus otiosus* in Hickory bark.

Bred adult April 29.
Wood county.

381. **Eurytoma sp. h.**

PRIMARY PARASITE.

Bred from galls on White Oak twigs.

Adults May.
Wood county.

382. ?**Diomorus Zabriskii**, Cr.

In Mines of Hymenopterous insect in outer Pine bark.

Adults May 3.
Hardy county.

383 **Torymus sp. a.**

Bred from galls on Willow and from Spruce bark infested with Scol tids.

Adults June 23.
Wood county.

384. **Lochites sp. a.**

PRIMARY PARASITE.

Attacks *Polygraphus rufipennis* in Spruce bark. No. 104 Catalogue West Va Scolytidæ 1893.

385. **Lochites sp. b.**

With Scolytids in Pine bark. No. 105 Catalogue West Va. Scolytidæ 1893.

386. **Lochites sp. c.**

Collected on Locust leaves with leaf gall and other insects

Adult May 30.
Monongalia county.

387. **Lochites sp d.**

PRIMARY PARASITE.

Attacks *Dendroctonus frontalis* in Pine bark. No. 106 Catalogue West Va. Scolytidæ 1893.

388. **Lochites sp. e.**

PRIMARY PARASITE.

Attacks *Tomicus cœlatus* in Norway Spruce bark. No. 107 Catalogue W. Va. Scolytidæ, 1893.

389. **Eupelmus, sp. a.**

Bred from Hemlock bark infested with *Melanophila fulvoguttata* and *Aulacus abdominalis.*

Adults April 1.
Monongalia county.

390. **Pteromalus sp a.**

PRIMARY PARASITE.
Attacks *Cecidomyia robiniæ* in Yellow Locust leaf galls.

Adults May 21; September 18.
Monongalia and Jackson county.

391. **Pteromalus(?) sp. b**

PRIMARY PARASITE.
Attacks *Phloesinus dentatus* in Red Cedar bark. No. 109 Catalogue W. Va Scolytidæ, 1893.

392. **Meraporus sp.**

SECONDARY PARASITE.
With *Pimpla inquisitor* pupæ in cocoons of *Orgyia leucostigma* on Maple.

Adults February 14; November 6.
Monongalia county.

393. **Gitognathus, sp. a.**

Common on Yellow Locust leaves infested with leaf galls *Cecidomyia robiniæ* and leaf miner *Odontota dorsalis.*

Adults May 20, 21, 25, 30.
Wood county.

394. **Gitognathus (?) sp. b.**

PRIMARY PARASITE.
Attacks *Odontota dorsalis* larvae in mines in Yellow Locust leaf.

Adults July 14
Monongalia county.

395. **Heydenia unica,** Cook.

Attacks *Dendroctonus frontalis* in Pine bark. No. 111 Catalogue West Va. Scolytidae 1893.

396. **Metastenus acanthocini,** Ashm.

In Black Oak twig.

Adults March 29.
Wood county.

397. **Hippocephalus nulbilineatus**, Ashm.

PRIMARY PARASITE.

Bred from Pine leaves infested with leaf miner *Gelechia pinifoliella.*

Adults bred July 13; May 20.
Wood county.

398. **Spintherus sp.**

Attacks *Polygraphus rufipennis* in Spruce bark No. 112 Catalogue W. Va Scolytidæ 1893

399. **Trigonoderus sp.**

Attacks *Polygraphus rufipennis* in Spruce bark. No. 113 Catalogue West Va. Scolytidæ 1893.

400. **Omphale bicinchis**, Ashm.

On Locust leaves infested by *Odontota dorsalis.*

Adults May 18. June 26.
Wood county.

401. **Tetrastichus sp. a.**

SECONDARY PARASITE.

Attacks Thanasimus larvæ.

402 **Tetrastichus sp. c.**

SECONDARY PARASITE.

Bred from *Apanteles sp.*, cocoon on *Apatela Americana* (?) larvæ.

Adults Jan. 28.
Monongalia county.

403. **Tetrastichus sp. d.**

SECONDARY PARASITE.

Attacks *Pimpla inquisitor* in chrysalis of *Orgyia leucostigma.*

Adults bred Jan 10. Larvæ Nov. 13.
Marion county.

404. **Tetrastichus racemariæ**, Ashm.

Bred from Oak galls infested with *Neuroterus noxiosus.*

Adult Feb. 20.
Wood county.

405. **Trisholcas euschiste,** Ashm.

EGG PARASITE.

Bred from Hemipterous egg in Locust leaf.

Adults June 22, 27.
Wood county.

406. **Bruchophagus sp**

Collected on Yellow Locust leaves infested with *Odontota dorsalis.*

Adults May 30.
Wood county.

407. **Decatoma sp**

Collected on Spruce logs infested with *Polygraphus rufipennis.* No. 115 Catalogue W. Va. Scolytidae, 1893.

408. **Lathromeris scutellaris,** Ashm. MS.

EGG PARASITE.

Attacks Lepidopterous eggs on Wild Cherry twigs.

Adults bred September 27.
Monongalia county.

409. **Chalcid,** (**Genus Nov.** ?)

PRIMARY PARASITE.

Attacks adult *Pityophthorus minutissimus* in Oak bark. No. 114 Catalogue West Va Scolytidæ, 1893.

Order HYMENOPTERA; Family PROCTOTRUPIDÆ.

410. **Aphalonomia hyolinipennis,** Ashm.

With *Hypothenemus sp. b.* in White Walnut. No. 116 Catalogue West Va. Scolytidæ, 1893.

411. **Leptacis sp. a.**

Collected on Yellow Locust leaves.

Adults May 18
Wood county.

412. **Leptacis sp. b**

Collected on Locust leaves

Adults May 21.
Wood county.

Order **HEMIPTERA**; Sub-order **HOMOPTERA**, Family **COCCIDÆ**.

(Scale Insects.)

413. **Undetermined species**.
On Pine twigs.

413a. **Pseudococcus aceris** (?) Geof.
On Soft Maple and Yellow Locust.

413b **Pulvinaria innumerabilis**.
On Soft Maple and Yellow Locust.

414. **Undetermined species**.
On Yellow Locust.

Family **APHIDIDÆ**.

(Plant Lice.)

415. **Undetermined sp. a.**
On Hawthorn twigs.

416 **Undetermined sp. b.**
On Box Elder twigs and leaves.

417. **Undetermined sp. c.**
On Yellow Locust twigs

418 **Undetermined sp. d.**
On Yellow Locust twigs.

419. **Pemphigus aceris**, Morell.
On Maple leaves.

420 **Pemphigus acerifolii**, Riley.
On Maple leaves.

421. **Undetermined sp. e.**
On Pine twigs.

422 **Undetermined sp. f.**
On White Pine leaves.

423. **Undetermined, sp. g.**
On Pine bark.

424. **Undetermined, sp. h.**
On Balm of Gilead.

Family MEMBRACIDÆ.

(Tree Hoppers.)

425. **Thelia, sp. a.**

On Yellow Locust twigs feeding on sap.

Adults April 27; Aug. 8; Oct. 3.
Monongalia county.

426. **Thelia, sp. b.**

Adults and nymphs feeding on sap of Yellow Locust twigs.

Adults June 23, 27; July 16. Nymphs June 27.
Wood and Hancock counties.

427. **Tetamona (?) sp. a**

Collected on Yellow Locust leaves.

Adults June 27.
Wood county.

428 **Ceresa bubulus.**

Frequent on Yellow Locust leaves and twigs.

Adults May 18; June 26, 27.
Wood county.

429. **Amphiscepa bivittata**, Say.

Collected on Locust leaves and tender branches

Adults Aug. 8.
Monongalia county.

430. **Amphiscepa sp. a.**

Collected on Yellow Locust leaves.

Adults August 16; September 14.
Monongalia county.

431. **Amphiscepa sp. b.**

Collected on Yellow Locust leaves.

Adults September 14
Monongalia county.

432. **Enchenopa binotata.**

Common feeding on sap of tender twigs on Yellow Locust.

Adults June 24, 25, 26, 27; July 16; August 8 Nymphs June 26

433. **Ophiderma salamandra,** Fairm.

Common on tender twigs on Yellow Locust, feeding on sap and attended by ants.

Adults June 13, 27; August 19. Nymphs August 8, 19.
Monongalia county.

434. **Smilia sp.**

Collected on Yellow Locust leaves.

Adults June 27; October 4.
Monongalia county.

Family CERCOPIDÆ.

435. **Aphrophora quadrangularis.**

Collected on Yellow Locust leaves and tender twigs.

Adults October 4.
Monongalia county.

436 **Undetermined sp. a.**

SPITTLE INSECT

Common on Pine, Spruce, Hemlock and Balsam Fir.

June and July '93.
Pocahontas, Randolph and Greenbrier counties.

437. **Undetermined sp. b.**

SPITTLE INSECT.

Common on Black Spruce twigs.

Nymphs July 11.
Tucker county.

438. **Undetermined sp. c.**

Common on Yellow and Scrub Pine twigs.

Nymphs May 20.
Wood county.

Family JASSIDÆ.

439. **Undetermined sp a.**

On Yellow Locust leaves.

Adults June 13; Oct 4.
Monongalia county.

440. **Undetermined sp. b.**

Collected on Yellow Locust leaves.

Adults June 12.
Monongalia county.

441. **Undetermined sp. c.**

Collected on Yellow Locust leaves.

Adults June 24.
Wood county.

Order HEMIPTERA; Sub-order HETEROPTERA.
Family REDUVIIDÆ.

(Bugs.)

442. **Sinea diadema**, Fab.

Collected on Locust leaves

Adults May 18, 24.
Wood county.

Family PHYMATIDÆ.

443. **Phymata Wolffii.**

PREDACEOUS.
Common on Yellow Locust and other trees, feeding on insects.

Adults Aug. 9; Oct. 8.
Monongalia county.

444. **Phymata sp. a.**

PREDACEOUS.
Collected on Locust leaves.

Adults Aug. 8.
Monongalia county.

Family TINGITIDÆ.

445. **Corythuca arcuata.**

Common on under side of Sycamore leaves, feeding on juices of leaf. Causes leaves to turn yellow.

All stages June 10, 13.
Monongalia and Harrison counties.

Family CAPSIDÆ.

446. **Calocoris sp. a.**

Collected on Yellow Locust leaves.

Adults June 10.
Monongalia county.

447. **Calocoris rapidus**, Say.

Collected on Yellow Locust leaves.

Adults June 10; Aug. 8.
Monongalia and Harrison counties.

448. **Calocoris, sp. b.**

All stages very common on Yellow Locust leaves and tender twigs Probably feeding on their juices.

Adults June 1, 10, 24, 27; July 16. Nymphs June and July.
Wood, Hancock and Monongalia counties.

449. **Calocoris, sp. c.**

Collected on Yellow Locust leaves.

Adult June 15.
Harrison county.

Family LYGÆIDÆ.

450. **Undetermined species a.**

Collected on Yellow Locust leaves.

Adults Aug. 8.
Monongalia county

Family COREIDÆ.

451. **Acanthocephalina, sp. a.**

Collected on Yellow Locust leaves.

Adults Oct. 3
Monongalia county.

Family PENTATOMIDÆ.

452. **Acanthosoma nebulosa**, Kirby.

Collected on Yellow Locust leaves.

Adult June 10.
Monongalia county.

453. **Nizara hirlaris**, Say

Collected on Yellow Locust leaves.

Adults August 6.
Monongalia county.

454. **Podisus sp. a.**

PREDACEOUS.

Feeding on leaf roller larvæ on Yellow Locust leaf.

Adults June 10 in leaves. June 13, feeding on larvæ.
Monongalia county.

455. **Podisus? sp. b.**

PREDACEOUS.

Nymphs feeding on Aphids on Yellow Locust twigs.

Nymphs October 4.
Monongalia county.

456. **Podisus? sp e.**

PREDACEOUS.

Feeding on Geometrid larvæ and Yellow Locust leaves.

Adults August 7. Eggs May 22.
Monongalia county.

457. **Podisus spinosus**, Dallas.

PREDACEOUS.

Feeding on Orgyia leucostgma larvæ on Locust leaves

Adults September 18
Monongalia county.

Order LEPIDOPTERA.

Family HESPERIDÆ.

458. **Eudamus tityrus**, Fabr.

Larvæ common feeding on Yellow Locust leaves.

Adults May 4; June; Larvæ August; October 4; Eggs June, August.
Wood and Monongalia counties.

Family LIPARIDÆ

459. **Orgyia leucostigma**, S & A

Larvæ common feeding on Maple and frequent on Yellow Locust.

Pupæ June 28; Larvæ June 26; September 22.
Monongalia and Wood counties.

Family LIMACODIDÆ.

460. **Empretia stimulea**, Clem.

Larvæ feeding on Yellow Locust leaves, also Blackberry leaves.

Larvæ August 8.
Monongalia county.

461. **Limacodes sp.**

Larvæ feeding on Yellow Locust leaves.

Larvæ August 15.
Monongalia county.

Family PSYCHIDÆ

462. **Thyridopteryx ephemeræformis**, Steph

Observed Cocoons on Red Cedar.

Family SATURNIIDÆ.

463. **Attacus promethea**, Dru

Larvæ common feeding on "Yellow Poplar" (Tulip Tree) Sassafras, Wild Cherry, and Persimmon leaves.

Adults June; Larvæ June; August 15.
Wood and Monongalia counties.

464. **Attacus angulifera**, Walk.

Larvæ observed feeding on leaves of Tulip tree.

Adults bred June 16 (1874.)
Jackson county.

465. **Attacus cecropia**, Linn

Larvæ frequent feeding on leaves of a variety of a forest shade and fruit trees. Observed on Maple, Persimon, Hickory, etc.

465*a* **Actias luna**, Linn.

Larvæ common on Hickory, Walnut and Sweet Gum.

466. **Telea polyphemus**, Cram,

Larvæ common feeding on Oak leaves. Taken also on Elm and Maple.

Adults August 2.
Fayette county.

467. **Hyperchiria io**, Fab.

Larvæ observed on Hickory and Maple.

Adults June 13.
Wood county.

Family CERATOCAMPIDÆ.

468. **Eacles imperialis**, Dru.

Larvæ common on Maple and Sycamore.

Adults July 31.
Monongalia and Kanawha counties.

469 **Citheronia regalis**, Fab.

Larvæ frequent feeding on leaves of Walnut, Hickory and Persimmon.

Adults June.
Monongalia county.

470 **Anisota senatoria**, S. & H

Larvæ common on Black and Scarlet Oaks, defoliating trees.

Adults July 12. Larvæ Sept. 10.
Wood county.

471. **Dryocampa rubicunda**, Fab.

Larvæ common feeding on Soft Maple leaves.

Family BOMBYCIDÆ.

472. **Hemileuca maia**, Dru.

Larvæ frequent feeding on White Oak leaves.

Adults October. Larvæ May 20.
Wood and Jackson counties.

Family COSSIDÆ.

473. **Prionoxystus robiniæ**? Peck.

WOOD BORER.

Larvæ common in wood of living Yellow Locust trees, also Oaks. Very injurious to wood.

Adults emerging June 13. Larvæ collected June 27.
Wood and Monongalia counties

474. **Cossus** sp.

Larvæ common in wood of living Oak trees. Very injurious to wood. Causes large black holes one-half to one inch in diameter.

Family NOCTUIDÆ.

475. **Hydrœcia nitula**, Gn.

Larvæ boring in tender sprouts of Yellow Locust and Maple.

Family GEOMETRIDÆ.

476. **Ennomos magnarius**, Gn.

Larvæ and Pupæ on Maple.

Adults bred October 3.
Monongalia county.

Family TORTRICIDÆ.

477. **Lophoderus politana**, How.

PINE TUBE BUILDER.

Larvæ feeds on Pine leaves. Forms tubes of the stumps of green leaves.

Family GRAPHOLITHIDÆ.

478. **Retinia Comstockiana**, Fern.

Larvæ bore in twigs and small branches on living Pitch Pine trees. Causes balls of turpentine to form where they enter the bark.

Larvæ June 27.
Wood county.

479. **Ecdytolopha insiticiana**, Zell.

LOCUST TWIG BORER.

Larvæ bore into the tender sprouts and twigs of Yellow Locust. Very injurious to young trees. Common.

Larvæ June 13; August 10; October 3.
Monongalia county.

Family GELECHIIDÆ.

480. **Depressaria robiniella** (?), Pack.

Larvæ feeding on Yellow Locust leaves.

Larvæ July 30.
Wayne county.

481. **Gelechia pinifoliella,** Cham.

PINE LEAF MINER.

Common in Yellow and Pitch Pine leaves. Causes tips of leaves to turn brown.

Pupæ May 20. Bred adults July 13.
Hampshire, Hardy, Grant and Wood counties.

Family LITHOCOLLETIDÆ

482. **Lithocolletes robiniella**, Clem.

LOCUST LEAF MINER.

Larvæ form blisters on under side of Yellow Locust leaves. Common.

Larvæ August 8.
Monongalia county.

Order DIPTERA; Family CECIDOMYIDÆ

483. **Diplosia resinicola**, O. S.

Observed.

484. **Diplosia pini-rigidæ**, Pack.

485. **Cecidomyia robinæ**, Hald.

LOCUST LEAF GALL-FLY.

Common and destructive Infests tender leaves causing galls on their edges.

Adults bred. Larvæ June, July.
Wood, Jackson, Hancock and Monongalia counties.

Family SYNPHIDÆ.

486. **Undetermined sp. a.**

Larvæ feeding on aphids on Yellow Locust.

Larvæ August 8.
Monongalia county.

487. **Undetermined sp. b.**

Larvæ feeding on aphids on Yellow Locust.

Larvæ October 4.
Monongalia county.

Family TACHINIDÆ.

488. **Tachina orgyia**, Twns.

Attacks larvæ and pupæ of *Orgyia leugcostigma* on Maple, Yellow Locust, etc. Common.

Adults bred October 2. November 5.

489. **Undetermined sp. a**

Chrysalids frequent in mines of *Monohamus scutellatus* in White Pine.

Chrysalids collected May 5.
Pendleton county.

490. **Undetermined sp. b.**

Attacks *Thanasimus dubius* adults on Pine.

Bred larvæ August 12. Pupæ August 13. Adult emerged August 28.
Monongalia county.

Family Anthomyiidæ.

491. **Anthomyia sp.**

Adult feeding on aphids on Yellow Locust leaves.

Adults October 3.
Monongalia county.

UNDETERMINED.

492. **Dipterous sp. a.**

Bred from larvæ taken in mines of *Polygraphus rufipennis* larvæ under Spruce bark.

Adult bred. Pupæ May 8. Larvæ March, August and September.
Randolph, Grant and Tucker counties.

493. **Dipterous sp. b.**

Larvae and cocoons common in mines of *Polygraphus rufipennis* larvae in Spruce bark. Common.

Adults bred April. Larvae and cocoons March, May, June, August, September.
Grant, Tucker and Randolph counties.

494. **Dipterous larvæ sp. c.**

In mines of *Polygraphus rufipennis* in Spruce bark.

Larvae March 29.
Tucker county.

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VOLUME III. NUMBER 9.

BULLETIN NO. 33.

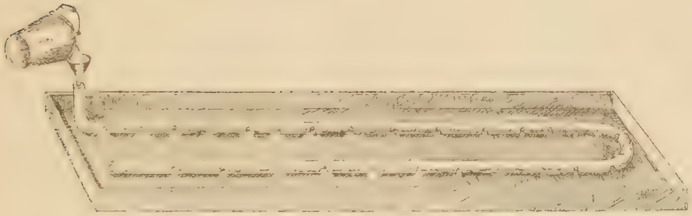
West Virginia Agricultural Experiment Station.

MORGANTOWN, W. VA.

SUB-IRRIGATION

—IN THE—

GREENHOUSE.



BY F. WM. RANE.

September, 1893.

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1893.

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SUB-IRRIGATION IN THE GREENHOUSE.

F. Wm. Rane, M. S.

During the past few years, this subject has invited more or less attention. It was not until the past winter, however, that special investigation has revealed its true value

Personal interest in this subject was awakened through association with Prof. W. J. Green, Horticulturist of the Ohio Agricultural Experiment Station, who was the first to recommend it to the public. Interest was furthered by observations made through experimentation during the winter of '91-'92 at the horticultural forcing-houses of Cornell University. In the latter place, a small greenhouse apartment was equipped especially for carring on experiments along this line. Unfortunately, no complete, tabulated data were procured on account of the burning of the plants, by neglect in smudging, one night towards the terminus of the experiment.

When constructing new forcing-houses at the Station here last fall, special arrangements were made for continuing the experiment in order to detemine, if possible, its value.

"Sub-irrigation." This compound word is derived from the Latin preposition "sub," which means under or below, and "irrigation," from the Latin "irrigatio," a sprinkling, a watering Sub-irrigation, therefore, is a sprinkling or watering from underneath the soil.

The effects of sub-irrigation upon plant growth in the greenhouse were first brought to notice when experimenting towards some efficient means of checking or exterminating the disease known as rot in lettuce. The truth or falsity of the theory that "frequent watering in the ordinary manner induces the disease" was arrived at by arranging to supply the plants with the requisite amount of water from beneath. Watering in this manner through punctured pipes or porous tiles, which were underneath the soil, was at that time thought to be by no means a decided success in exterminating the lettuce rot; however, marked results were noticeable in that the sub-irrigated beds were more productive in vegetation than those watered in the ordinary manner.* From this as a starting point, the history of sub-irrigation in the greenhouse begins. Outside of those pursued in Ohio, we know of no other experiments undertaken in this line of investigation except our own.

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*See Ohio Bulletin, Vol. V., No. 6, page 101.

The experiments at Cornell University were conducted in two beds, each 8 feet long by 3 feet wide, containing close-fitting bottoms. In one of the beds, one-inch iron pipe was coiled as in the cut.

This pipe was punctured on the sides at intervals of eight inches, in order to distribute the water The other bed was used as a check to the first, and was watered on the top in the usual way. Soil to the depth of six inches was placed in each bed, and plants of various structures were similarly planted in rows in the two beds.

Plants were selected with reference to their individual nature. As examples of those plants, the foliage of which is the part desired, lettuce and spinach were selected. As plants for root development, radishes and beets were taken, and those grown for their blossoms, daisies and sunflowers.

Up to the time the plants were destroyed, the results showed a marked difference in many respects. Some of the points particularly evident in favor of sub-irrigated beds were:—

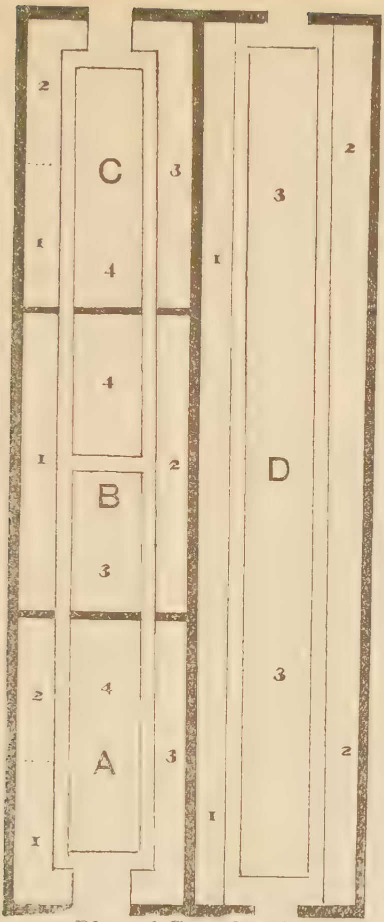
(1) A greater uniformity of growth.
(2) A great saving of labor in watering.
(3) Drying up of the under leaves instead of their becoming slimy and decayed as in surface watering.
(4) Easy cultivation of the soil.
(5) A more luxuriant growth.

Earliness in maturity of lettuce and spinach was noticeable. There was no perceptible difference in the growth of the radishes and beets, which were of the turnip-rooted varieties. Daises and sunflowers were much in advance in the sub-irrigated bed.

Experiments at the Station.

During the past winter, three beds were arranged for sub-irrigation, one in each of three houses of the following dimensions:

House A, 9 feet 6 inches by 3 feet 6 inches; house B, 6 feet 6 inches by 8 feet 9 inches, and house C, 9 feet 6 inches by 3 feet 6 inches. Each bed was made perfectly water-tight by the use of matched material. In the bottom of these beds was laid one and one-fourth inch pipe with punctures on the sides four inches apart.



Plan of Greenhouses.

Beds in houses A and C contained iron pipes arranged for watering in the following manner. Two parallel pipes were placed in the bottom twenty-one inches apart, and connected by elbows at one end, making them continuous. Of the two opposite ends in house A, one was closed by a cap, while the other was run up perpendicularly for at least two inches above the soil or top of the bed. See cut. In house C, instead of capping one of the opposite ends of the pipe, both were left open and carried above the surface of the soil by the use of elbows, as in house A.

The bed in house B contained lead pipe, which was easily adjusted to the desired position on account of its flexibility. It was placed similarly as in the other beds. Since the bed was much wider, three parallel pipes instead of two were placed with the ends protruding above the top of the bed at opposite corners. Instead of

leaving one continuous pipe, the central parallel was cut in the middle, and the ends hammered together and soddered, thus forming two pipes.

The punctures through which the water emerged from the pipe were four inches apart, and made with reference to as even a distribution as possible. This was accomplished to some degree by drilling holes low down on the sides of the pipe at the further end from where the water was poured in, and gradually raising them towards the other end, making the last one drilled come near the top of the pipe. Soil to the depth of six inches was then placed on the benches, covering the pipes out of sight.

When the right conditions were secured in each of the beds for transplanting plants and sowing seed, experiments were begun, the results of which are given in the following pages.

Parsley.

Parsley.

On December 20, 1892, eight rows of moss-curled parsley seed were sown in beds 1 and 2, house A, five in bed 1 in ordinary, and three in bed 2 in sub-irrigation. Also, on the same date, eight rows of fine double-curled parsley seed were sown in beds 1 and 2, house C; five rows in bed 2 in ordinary, and three in bed one in sub-irrigation. The first parsley was picked for market on February 2, 1893. in the sub-irrigated beds of houses A and C. When parsley was ready for market in these beds, that in the surface-irrigated beds was not over one-third grown.

The plate shows a photograph of the two varieties of parsley grown in the respective beds. Bunches I and IV. represent the fine double-curled variety from beds 1 and 2, house C. Bunch I shows the average size in the five rows in surface-irrigated bed, and is about

one-half grown, while IV. presents the same variety in the sub-irrigated portion of the bed, out of which the largest had already been marketed. Bunches II. and III. represent the moss-curled parsley from beds 1 and 2, house A. Bunch II. gives the size of that in the five rows in surface-irrigated bed, while III. represents the same variety from the three rows in the sub-irrigated portion. The difference in maturity of parsley from seed, therefore, was very marked in favor of sub irrigation. After the parsley in the surface-irrigated beds once reached maturity, there was no perceptible difference in its growth from that in the sub-irrigated bed.

Parsley is grown for its leaves, which are used in garnishing meats, etc.; therefore, only the leaves are picked off and these are generally sold in bunches, as shown in the plate. Immediately after the leaves are picked for market, the roots send forth a new growth. Bunches I. and II. are from the surface-irrigated and III. and IV. from the sub-irrigated beds.

Tomato Plants.

On March 28th, tomato plants, which were grown from seed sown on the 20th of December, and handled on January 28th, were placed in permanent beds. These tomatoes were all pruned, allowing a crop of lettuce to grow underneath them, thus receiving a double crop from the same area. For the experiment, bed 4, house A, was selected for surface, and bed 3, house B, for under-surface watering. While bed 4, house B, was used as a second check to bed 3. All the blossoms were hand-pollinated two or three times a week. The plants were placed 18 inches apart each way, and trained to one main stem. Each was held in place by a strong cord stretched from the base of the plant to the rafter of the greenhouse directly above, to which the plant was tied as it grew. This cord was kept in position by tying it to a small nail tacked in the rafter, while a peg stuck in the soil at the base of the plant served as a fastener at the other end. The plants were labeled and numbered consecutively in both beds, so that notes could be taken for each plant. Plants were selected with reference to similarity in size, structure, etc. They were transplanted somewhat later than they would have been, had we not been delayed a little by the tardy completion of the houses. The question of earliness, however, does not detract from the value of the experiment, for, although perhaps the weight of the fruit was not as great as it would have been had the vines been given more time, yet the comparative values of the beds were the same. All the fruit, of course, did not ripen at one time; therefore, it was necessary that the fruit be picked and weighed as it ripened, each plant being fully credited in the notes. When the experiment was concluded, the sum of the various weights gave the total product from each vine. The following tables show the comparative test of beds 4, house A, and 3, house B, above referred to.

Beds.	VARIETIES.						
4	Canada Victor.	Beauty.	Smooth Red.	Perfection.	Acme.	Conquer.	Octamus.
	Weight.	*Weight.*	*Weight.*	*Weight.*	*Weight.*	*Weight.*	*Weight.*
HOUSE	2 ℔ 14 oz.	1 ℔ 6 oz.	2 ℔ 3 oz.	1 ℔ 6 oz.	10 oz.	3 ℔ 2 oz	1 ℔
A	1 ℔ 5 oz.	11 oz.	2 ℔ 5 oz	1 ℔ 6 oz	1 ℔ 3 oz.	2 ℔ 1 oz.	14 oz
	3 ℔ 2 oz.	1 ℔ 2 oz.	1 ℔ 3 oz.	13 oz.	1 ℔ 14 oz.		2 ℔
SURFACE	2 ℔ 13 oz	1 ℔	13 oz.		1 ℔ 3 oz.		2 ℔ 13 oz.
	3 ℔	1 ℔ 10 oz.			3 ℔ 11 oz.		3 ℔
IRRIGATION.	1 ℔ 13 oz.	2 ℔ 2 oz.			2 ℔ 6 oz.		
	8 oz.				1 ℔ 2 oz.		
	2 ℔ 10 oz.						
Average......	2 ℔ 4 oz.	1 ℔ 5 oz.	1 ℔ 10 oz.	1 ℔ 3 oz.	1 ℔ 14 oz.	2 ℔ 9 oz.	1 ℔ 15 oz.

VARIETIES.

Beds.	Canada Victor.	Beauty.	Smooth Red	Perfection.	Acme.	Conquer.	Octamus.
	Weight.	*Weight.*	*Weight.*	*Weight.*	*Weight.*	*Weight.*	*Weight.*
3 HOUSE	1 lb 8 oz.	1 lb 6 oz.	3 lb 5 oz.	2 lb	2 lb 2 oz.	3 lb 11 oz.	3 lb 5 oz.
B	2 lb 10 oz	11 oz.	2 lb 8 oz.	1 lb 6 oz	2 lb 8 oz.	1 lb 8 oz.	1 lb 3 oz.
	2 lb 11 oz.	1 lb 8 oz.	2 lb 2 oz	2 lb 2 oz.	3 lb 6 oz.		
SUB-	3 lb 6 oz.	3 lb 8 oz	2 lb 3 oz				
			1 lb 13 oz				
IRRIGATION.			4 lb 3 oz.				
Average......	2 lb 9 oz.	1 lb 12 oz.	2 lb 11 oz	1 lb 13 oz.	2 lb 11 oz.	2 lb 9 oz.	2 lb 4 oz.

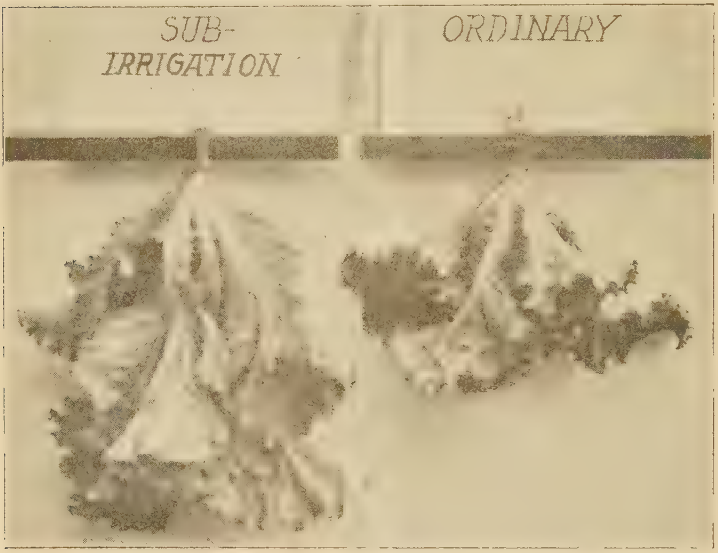
Individuality in plants varies, and experimental results can be relied upon only when a general average is taken. In a majority of cases, although the individual plants run comparatively evenly in each bed, as is found to be the case from the tables, nevertheless it does not necessarily hold true that the bed showing the greatest average always has the individual plants of the greatest weight. This is shown to be the case with the Acme variety, for one plant, in bed 4, house A, happened to produce even more fruit than any of those in bed 3, house B, of the same variety. This was an exceptional case, as is shown by the remaining varieties. The fact of its possibility is accepted as a natural occurrence by those who have had experience with plants. The averages, therefore, of a number of plants of the same variety establish their individual value. The comparative values found in the tables show the marked superiority of the method of sub-irrigation.

RADISHES.

VARIETY.	Sub-Irrigation.				Ordinary Irrigation.					
	Bed 2 House A.		Bed 1 House C.		Bed 1 House A.		Bed 2 House C.		Bed 3 House A.	
	Total Weight.	*No. Mktble.*	*Weight.*	*No. Mktble.*	*Weight.*	*No. Mktble.*	*Weight.*	*No. Mktble.*	*Weight.*	*No. Mktble.*
Olive Carmine. (Turnip-rooted).	1 ℔ 14 oz.	50	1 ℔ 3 oz.	29	2 ℔	55	1 ℔ 8 oz.	50	1 ℔ 5 oz.	40
Early Short Top. (Long-rooted).	2 ℔ 10 oz.	24	4 ℔ 10 oz.	36			3 ℔ 13 oz.	19	2 ℔	12
Early Bl'd Tur. (Turnip-rooted).	1 ℔ 3 oz.	12	2 ℔ 2 oz.	26	2 ℔ 6 oz.	23	2 ℔ 3 oz.	23	1 ℔ 2 oz.	12

The effects of the two methods of irrigation upon the growth of radishes are fairly shown in the table above, in which both the long and turnip-rooted varieties are used as examples. On the whole, no marked difference was observable in the productiveness of the turnip-rooted varieties in either bed. The effect was noted to be very beneficial in the case of the long-rooted radishes in weight, maturity and number marketable.

Lettuce.



Hansen.

No crop seems to be more affected by sub-irrigation than does that of lettuce. During the past winter, three crops of lettuce were grown in each of the larger portions of the various beds in the forcing-houses. The first two were given the entire space, while the last was grown under tomato plants, which were pruned and which served as a shade to protect the lettuce from the extreme heat of the sun in early spring. Notes were taken frequently and at each harvesting, the crops were weighed and results recorded. In addition to weight as an evidence of the superiority of the method of sub-irrigation, height, quality, earliness, etc. are also important points of proof.

The first crop was at least 25 per cent. better in the sub-irrigated beds, and was ready for market from ten days to two weeks before that in the other beds. At this time, one was nine inches and

the other $11\frac{1}{2}$ inches high. The difference, therefore, in four weeks growth was a gain of $2\frac{1}{2}$ inches in favor of sub-irrigation.

Frankfort Head.

The second crop was even more marked in its differences than the first. The accompanying photographs of lettuce exemplify the comparative merits of the two systems of watering with as many varieties of lettuce,—the Boston Curled, the Hanson, and the Frankfort Head. In the case of the Frankfort Head, the small heads were formed as perfectly as the large ones. With the open-headed varieties it is different: their maturity is considered reached when they have attained the desired size. One point in favor of sub-irrigated beds with lettuce is that it is ready for cultivation at all times, while the surface-watered beds are liable to contain more or less moisture, rendering cultivation less frequent. The cultivation of lettuce is for the most part performed during its younger stages, for as it matures, the more it fills up space, and the harder it is to manipulate the tools for cultivation Sub-irrigated lettuce contains less chlorophyl; therefore is lighter in color.

Boston Curled.

Damping Off.

A comparative test of the various beds with reference to the damping off of the plants soon after transplanting is shown in the accompanying table. The plants were affected about equally by the disease in each instance, making the proportion between sub-irrigation and surface-watering as ten is to eleven.

VARIETY.	SUB-IRRIGATION.			NON-IRRIGATION.		
	Bed 2, House A.	Bed 2, House C.	Bed 3, House B.	Bed 1, House A.	Bed 1, House C.	Bed 4, House B.
Black Seeded Simpson, . . .			1			1
Hanson, ...			2	1		2
Frankfort Head, . . .		6				
Boston Curled, ...	1					2
Grand Rapids, ...				1	4	
Total, ...	1	6	3	2	4	5

Lettuce Rot.

The lettuce rot, which appeared to a marked extent in the surface-watered beds was apparently absent in the sub-irrigated beds. The disease was first noticed at time of marketing at which time it could not be detected in the other beds. During the growth of the second crop, it became very troublesome, and some of the varieties in the surface-watered beds required marketing before they were fully grown, while in the under-surface watered beds, the disease was completely held in check.

Spinach

A slight difference was shown in earliness of maturity in favor of sub-irrigation. The plants started their seed stalks from one to two weeks earlier than those in ordinary irrigation.

Beets.

The turnip-rooted varieties of beets were placed in each of the beds. No marked difference was noticeable in either instance as the production was nearly equal in the beds. Beets take considerable time to mature in the greenhouse and hence are not a profitable crop as regards the vegetable itself. The comparison of the results from the same variety in ordinary and sub-irrigation, after having been transplanted 65 days, was: 16 beets in the former, weight 1 lb. 4 oz.; fifteen beets in the latter, weight, 1 lb. 2 oz.

Practical Conclusions.

The question of sub irrigation in the greenhouse is one worthy of consideration by all who have interests at stake in the pursuit of floriculture or forcing of vegetables. The exact merits of the method, whether used in or out of doors, cannot be arrived at until tested generally. We can easily see how its use might, in the hands of the inexperienced, be even misleading. The water is taken up by the soil through capillary attraction, which requires some time for complete action. The conditions are not normal if more water is used than is necessary, or if the requisite amount is lacking. Good judgment on the part of the operator is important. Thus it is with surface irrigation. In proportion as good judgment is exercised, good results will be secured.

Now, one point which the writer wishes to emphasize is that in sub irrigation, better results are obtained on account of its being a more complete system of watering. It has been our experience that in the majority of cases where plants in beds were not doing well, and where no external cause could be attributed, examination revealed the fact that the trouble was due to inefficient watering. In many cases the soil at a depth of three or four inches would be either dry and porous or baked hard. In numerous greenhouses visited the past year, we frequently noticed spots or portions of beds which seemed to remain dormant, although the conditions were apparently the same as those of the remaining por-

tions of the beds. On examination, however, the cause was found to be inefficient watering. Now, when we stop to think that capillary attraction is one of Nature's ways in which moisture travels, it is evident that sub-irrigation is the more natural method of applying water to the soil. For an experiment, we took two similar beds of dry soil, using the methods of surface and under-surface irrigation. While watching the results, we found that if the water was insufficient to moisten the whole of the bed, it did not penetrate perhaps over half way in the case of surface watering, and thus only the upper portion of the soil was of the right moisture. On the other hand, in the case of under-surface watering, the water was applied at the bottom of the bed, and capillary attraction caused it to ascend only half way. The difference between the two beds now is that one has the appearance of being in the right condition for seed or transplanted plants, while the other has not yet that appearance The condition in the one instance is deceiving, while in the other it is not. More water must be added to the sub-irrigated bed to make right conditions, while it is not necessarily so in the other.

It is already a demonstrated fact that when we apply water to soils out of doors in summer under ordinary circumstances, the greater portion of it goes off in the atmosphere; and in order to give the plants the requisite amount of moisture about the roots, a superabundance of water must be used. In the greenhouse, the external conditions are the same to greater or less an extent, and the above laws, therefore, hold true. Now, if we can apply the water directly underneath the soil by sub-irrigation, we overcome to a great extent this evaporation. It was found to be a fact that these sub-irrigated beds required very little water in comparison with the others.

The saving of labor through sub-irrigation is almost inestimable. The expenditure of time in watering was as follows: in the case of under-surface irrigation, the water was dipped out of a tank and poured into a funnel, through which it entered the various portions of the bed. On the other hand, in surface irrigation, the water was dipped out and applied by a sprinkling can, containg either a rose spray or a spout long enough to reach all sections of the bed. In the former case, the size of the plants did not matter, while in the latter, the more mature the crop, the more time it required for watering. Again, the sub-irrigated beds did not require watering over once or, at the outside, twice a week. While, generally speaking, the other beds were watered daily.

The idea that a water-tight bed is detrimental to plant growth on account of lack of drainage is overcome, we believe, in the fact that the pipe or tiles receive the excess of water, which, in a bed not water-tight, would leak out at the bottom, thus making it serve a double purpose. If the soil contains too much moisture, it serves as a reservoir; if not enough, it imparts the amount necessary for good conditions. In either case, the pipe or tiles act as a safety-valve. These openings underneath the soil allow free access of air, render plant food digestible, and act as a drain to water-soaked

soil. In view of these results, we feel safe in saying that under-surface watering is a pronounced success.

The question of economy when considering the advisability of using sub-irrigated beds, is justly a worthy and important one. There must be a water-tight bed to retain all the water in the soil, the construction of which is necessarily more expensive than in the ordinary method of making beds, provided boards are used. The pipe or tiles are likewise an extra expense. Now, will this expenditure be realized from the advantages gained?

The cost of raw material, for example, in two houses, each 50 feet long and 20 feet wide, one being arranged for surface and the other for under-surface watering, would be about as follows:—

SURFACE.		UNDER-SURFACE.	
Center bed 40x8 ft. @ $12 per M	$ 3.84	Center bed 40x8 feet @ $25 per M	$ 8.00.
2 Side Benches 50x4ft. @ $12 per M	4.80.	2 Side Benches 50x4 ft. @ $25 per M	10.00.
182 ft. Sideboards @ $20.	3.64.	182 ft. Sideboards @ $20	3.64.
		150 ft. Quarter round @1ct.	1.50.
		320 ft. Tile @ $18 per M	5.76.
		White Lead	$1.10.
Total	$12.28.	Total	$30.00

The difference between the first cost of the beds in the two houses is, therefore, $17.72. Dividing this amount by two, since the beds will certainly last two years, we have $8.86 as the actual yearly expense of the one house over the other. The fact of this small expenditure in comparison with the great advantages derived from it, establishes its economic importance and thorough practicability.

Lead or iron pipe may be used in place of the tiles but are not as practicable when a quantity is to be used. They are more expensive, and better adapted to smaller areas. Lead pipe costs 6 cents per pound, the number of pounds to the foot varying according to the quality. It gives very satisfactory results, and can be used indefinitely. The cost of iron pipe varies according to the size. Although it is less expensive than the lead, it rusts easily, and can not be relied upon after one or two seasons' use. That used the past season, after having been cleaned, is in fair condition for use this year.

In view of the results obtained, it is demonstrated that sub-irrigation is a pronounced success. We heartily recommend it to the public.

A new forcing-house, 20x60 feet, has been fully equipped at the Experiment Station for sub-irrigation and we expect great returns from it this season. The center bed is 8x50 feet, and sides 4x60 feet.

We are now turning our attention towards methods for securing

a perfectly water-tight bed. Feeling assured that under-surface watering is a success. If we can now determine what is the most economical manner of constructing water-tight beds, we will have advanced a step in the evolution of greenhouse problems. With this idea in view, various materials such as galvanized iron, zinc, Georgia Pine, cement, etc., are being tested in the hope of arriving at some definite, advantageous results.

SUMMARY.

1. Sub-irrigation is a more complete system of watering.
2. The soil never becomes surface hardened.
3 Beds never bake or dry out in the bottom.
4. The appearance of the beds is not deceiving, as is sometimes the case in surface watering.
5. Plants run more evenly than in surface-watered beds.
6. Fungous diseases are held in check.
7. A great saving of time.
8. A great saving of labor.
9. The soil can be worked at any time, and thus kept in better condition.
10. Less water is required
11. The beds require watering once a week, while surface irrigation generally needs it daily
12. The yearly excess of cost in a house 20x50 feet is not over $8.86.
13. The pipe or tiles serve both to water the beds and retain the excess of moisture.
14. The openings underneath the soil allow free access of air; hence soil never becomes sour or stagnant.
15. Parsley was ready for market when it was only a third grown in surface-irrigated beds.
16. There was a marked gain in production of tomatoes.
17. Long-rooted radishes were proved superior.
18. Lettuce was thirty per cent. better.
19. Lettuce rot was held in check
20. Spinach matured earlier.
21. Under the conditions here present, sub-irrigation is more economical than surface watering and more satisfactory in every way.

F. Wm. Rane.

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MORGANTOWN, W. VA.

FERTILIZER ANALYSES

—FOR THE—

Year Ending December 31, 1893.

ANALYSES

By DR. R. J. J. DE ROODE.

JOHN A. MYERS,

December, 1893.

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GENERAL STATEMENT.

JOHN A. MYERS

This bulletin gives the chemical analyses and relative commercial value of all the fertilizers offered for sale in the State. The number of brands offered during the past year is 142. The table of analyses shows the analysis and valuation of each sample as determined by us, and also gives the valuation at the same figures based upon the minimum claims of the manufacturers. In practice, the minimum claims are usually what the manufacturer aims to furnish the farmer. By comparing the analysis with the guarantee, the farmer will readily see how close the manufacturers are running to their guarantee. Take for example "Star Brand Tobacco Manure," the first on the list. Reading across the page, we come first to the analysis of this brand as determined in the Station laboratory. Next, the valuation based upon this analysis; then comes the valuation based upon the guarantee of the manufacturer, followed by the analysis as guaranteed by the manufacturer. After which follows a comparison of the valuations. In this case "excess of value by analysis, $2.88," which means that the sample submitted to us analyzed better than guaranteed by the manufacturers, to the value stated, and that the farmer gets full value for money paid. Running down the column, we come to Orchilla Guano, manufactured by the Wooldridge Fertilizer Co., Baltimore, Md., which, by, analysis, is worth $8.72; by guarantee, worth $18, making a deficiency of $9.28, showing that this brand offers little inducement to the farmer to invest in it. Whenever the sample submitted by the manufacturer shows an excess of valuation in the "guarantee column amounting to as much as $1.00 over the valuation based upon analysis, it is advisable for the farmer to buy some other brand.

There is this year a very marked reduction in the percentage of fertilizers sold upon higher guarantees than their merits justify. When the inspection began two years ago, 26% of the brands of fertilizers sold in this State were being misrepresented as to their composition and were being sold upon excessive guarantees. This year it has been reduced to 11%, counting all brands that are short. There are, however, in this some brands which are evidently short

from pure accident, as it only amounts to a few cents. If we were to allow a variation of $1 per ton due to unavoidable errors in manipulation, sampling and analysis, there are only five brands in the 142 that are really short, reducing the number of deficient brands to 3½%. This indicates a very commendable effort upon the part of manufacturers to supply fertilizers equal in every respect to their minimum guarantee, and the saving, in this matter alone to the farmers, will, doubtless, in the aggregate amount to many times the entire cost of conducting the inspection, besides protecting honest and reliable fertilizer firms from the pretentious claims of fraudulent manufacturers and dishonest dealers.

Farmers will do well to accustom themselves to buy *plant food* rather than *brands* of fertilizers. A comparison of the analyses will show that there is relatively little variation in the composition of the ammoniated superphosphate offered for sale by the several manufacturers, and the farmer will often be able to save considerable money by remembering that the "phosphate of A." is as good as the "Phosphate or S. C Dissolved Bone of M " provided the chemical analysis of the two is the same. It may be well, also for the farmer to remember that the "Grass Grower" probably comes from the same heap in the ware room that the "Buckwheat-Grower" comes from, and that there is nothing of merit in the name. The manufacturers are compelled, in many cases, in order to economically use their raw material, to manufacture different brands which are sold under various names. We are free to say that we think the manufacturers make a mistake in laying so much stress upon a particular brand of fertilizer, but perhaps the lack of information among the farming classes in regard to the use and adaptation of commercial fertilizers has compelled them to pander to this idea. It will be better for the manufacturers, in our judgment, and also for the farmer to buy the fertilizers, and transact all of their business in fertilizers upon the basis of chemical composition Both parties in that case may know exactly what they are doing, and it takes the element of empiricism, out of the business, and establishes it upon a strictly scientific basis. It may, perhaps, be a long time before the farmers are prepared to act upon this suggestion, but the manufacturers buy their crude materials upon the basis of chemical analysis, and the sooner this system is extended to the entire business, the better for all parties concerned.

There have been reports of a few violations of the law that have reached this office, but upon investigation it was found that there was insufficient grounds for prosecution Three cases are being investigated at present where there have been apparent intentional evasions of the law, which may require prosecution.

As is always the case, there have been a few disputes with manufacturers in regard to the accuracy of the analytical work, but in every case a review of our analysis has shown that our chemist was correct, and that the error or mistake had occurred either in the factory or in the laboratory of the manufacturer. We suggest that the manufacturers in every case retain a part of the sample sent us for

analysis, as most frequently they may find the cause of the error exists outside of our laboratory. Every possible provision is made for securing accurate results in our station laboratory, and no analysis is sent out until the sample has been analyzed in duplicate, starting the duplicates upon different days. The methods of analyses pursued are strictly those adopted by the Association of Official Agricultural Chemists, and our results, when transmitted to the manufacturers or to the farmers, we consider in all cases to be of sufficient accuracy to rely upon in any cases of litigation that may arise.

The table of valuation for last year was changed, as it was found that the prices adopted the year before were not sufficiently close to the actual commercial value of the fertilizer. It is impossible in a State like West Virginia to adopt a scale of prices that would be suited to all sections of the State, and hence we use simply a relative commercial valuation, which is reasonably close to the prices that farmers would have to pay for fertilizers of these particular grades. The German potash compounds are under the control of a syndicate or trust, which has adopted the following prices for 1894, for quantities of less than 12 tons:

Muriate of Potash,	guaranteed	80%,	$ 2.32	per	cwt.	in N Y.
Sulphate of Potash,	"	90%,	2.70	"	"	"
Sulph. Potash-Magnesia,	"	48%,	1.46	"	"	"
Kainit,			10.75	"	ton	

Any of the above bought in bags, $1 25 extra. The price of the above compounds is about 5 cents more per hundred in Baltimore than in New York. This does not include the freight rate from New York to point of destination. Correspondence in regard to these fertilizers should be directed to German Kali Works, Office 707 Bennett Building 93-99 Nassua St., New York.

Uuleached Canadian Ashes can be had through any of the parties advertising their sale in the agricultural papers. This is a very valuable source of Potash, and is especially commended to the consideration of farmers wishing fertilizers for fruit trees, tobacco. and potatoes. So far as known to us, the ashes are not used in this State, but should be.

The attention of the farmers is also called to the value of Ground Tobacco Stems which are a valuable nitrogenous fertilizer containing small per cents of potash and phosphoric acid, and at the same time act as in insecticide or more properly insect repellent Parties interested in the application of fertilizers to melons will find this compound, especially when fresh and strong, a valuable material to use both as a fertilizer and as a protective measure against the onslaughts of insect pests.

Another compound worthy of careful consideration as a fertilizer is Cotton Seed Meal which is a very valuable nitrogenous fertilizer.

During the year there were sold in the State about 7,500 tons of fertilizer. There is complaint upon the part of some of the manufacturers that the farmers purchase almost exclusively low grade or cheap fertilizer. It would be well for the farmers to remember that a pound of plant food is worth about so much money, and if a manufacturer sells a low priced fertilizer, the probabilty is that he sells relatively few pounds of plant food, for the reason that it is impossible to prepare first class goods at third class prices. It is believed to be cheaper for the farmer to buy the higest grade of fertilizers than to by low grade goods. And under all circumstances commercial fertilizers should only be used to supplement the home product. Every source of production of manures upon the farm should be utilized before it is thought advisable to invest in commercial fertilizers, but it is very doubtful whether the cultivation of the grains and garden stuff can be made profitable in this State, without the liberal use of some of the concentrated commercial fertilizers.

Valuations for 1893.

The actual commercial value of a fertilizer depends upon so many conditions, such as demand and supply; speculative influences; freight rates; the credit of the purchaser, and the amount of competition, that it is not possible in this State to adopt a scheme of valuation which will exactly suit every locality in the State. We, therefore, adopt a system of valuation which is intended to indicate the *relative commercial value* of the several brands of fertilizers sold in the State. For some sections of the State, our valuations are lower than the actual commercial value of the fertilizers, while for other sections, they are higher than the prices at which the fertilizers are sold. This is unavoidable, and it is advisable for farmers or agents contemplating investing in fertilizers to correspond with a number of firms in regard to the prices at which they will deliver the fertilizers in car load lots.

The valuation adopted by us is quite close to the actual price at which fertilizers of the quality indicated can be had at any point in the State. It makes no allowance for the variation in freight rates, which is a small matter, and it neglects the agent's commission, which is a private contract.

It does not represent the agricultural value of the fertilizer, which depends upon the soil, the weather and the crop fully as much as upon the character and amounts of the ingredients of the fertilizer.

The following is the scale of prices used in making the relative commercial valuations:

Nitrogen in mixed fertilizers, ...	20 c.	per lb.
" fine bone and tankage, ...	13 c.	"
" coarse bone and tankage, ...	8½c.	"
" vegatable compounds, ...	15 c.	"
Available phosphoric acid, ...	6 c.	"
Insoluble " " in fine bone & tankage,	5 c.	"
" " " in coarse bone & tankage,	3 c.	"
" " " in ground rock, . .	2 c.	"
Potash soluble in water, ...	5 c.	"

The relative commercial value of a fertilizer is determined as follows:

Take the analysis of any brand and multiply the percentage given by the price of the ingredient, then by 20 to reduce to tons, add the several products, and the result will be the valuation as follows:

Available Phosphoric Acid.	11% x 6x20	$13.20
Insoluble " "	3% x 2x20	1 20
Nitrogen " "	3% x20x20	12 00
Potash " "	2% x 5x20	2.00
Relative commercial value per ton,		$28.40

LAW RELATING TO THE SALE OF COMMERCIAL FERTILIZERS IN WEST VIRGINIA

CHAPTER LXXII.

AN ACT concerning Commercial Fertilizers and repealing chapter twenty-five of the Acts of the Legislature of West Virginia of 1879.

[Passed March 6, 1891.]

Be it enacted by the Legislature of West Virginia:

1. Every person or company who shall sell, offer or expoes for sale, in this State, any commercial fertilizer or manure, shall affix conspicuously to every package thereof a plainly printed statement, clearly and truly certifying the number of net pounds of fertilizer in the package, the name, brand or trade-mark under which the fertilizer is sold, the name and address of the manufacturer, the place of manufacture, and a chemical analysis. stating the percentage of nitrogen or its equivalent in ammonia, of potash soluble in distilled water, and of phosphoric acid in available form, soluble in distilled water, and reverted, as well as the total phosphoric acid. In the case of those fertilizers which consist of other cheaper materials, said labels shall give a correct general statement of the composition and ingredients of the elements relied upon, contained in the fertilizers which it accompanies. If any such fertilizer be sold in bulk, such printed statement shall accompany and go with every lot and parcel sold, offered or exposed for sale.

2. Before any commercial fertilizer is sold, offered or exposed for sale in this State, the manufacturer, importer or party who causes it to be sold, exposed or offered for sale, shall file with the Director of the West Virginia Agricultural Experiment Station a certified copy of the statement named in section one of this Act, and shall also deposit with said Director, a sealed glass jar or bottle, or sealed tin can, containing not less than one pound of fertilizer named and described in said statement, accompanied by an affidavit that it is a fair average sample thereof. The making of any affidavit required by this chapter falsely, shall be perjury.

3. The manufacturer, importer, agent or seller of any brand of commercial fertilizer or material used for manurial purposes, shall pay for each brand at the time he files the statement required in section one of this Act, an analysis fee of ten dollars for each of the fertilizing ingredients claimed to exist in each and every brand as

fertilizer which he sells, offers or exposes for sale within this State, provided that whenever the manufacturer, or importer, shall have paid the analysis fee herein required, for any particular brand of fertilizer, no agent or seller shall be required to pay any other or further analysis fee for said brand.

4. The analysis fee required to be paid by section three of this Act shall be paid to the Treasurer of the West Virginia University for the use of the Agricultural Experiment Station, and the party making such payments shall take from said Treasurer triplicate receipts therefor, one of which he shall retain, and the others shall be deposited, one with the Director of the Agricultural Experiment Station, and the other with the Secretary of the Board of Regents of the West Virginia University, and by them filed and preserved in their respective offices.

5. Immediately after the filing of the receipt aforesaid with the Director of the Agricultural Experiment Station, said Director shall issue a certificate to the party making such payment, stating the amount of fees paid, and the name, brand or trade-mark under which the fertilizer is sold, the name and address of the manufacture or importer, the place of manufacture and the name and place of business of the dealer, and chemical analysis as set forth in the statement by section one of this Act, and that the applicant for said certificate is authorized to sell said fertilizer within the State of West Virginia for the period of one year from the first day of January to the 31st day of December, inclusive. Said certificates may be issued at any time for and during the current year, and may be issued during the month of December for the year commencing on the first day of January thereafter.

6. It shall be the duty of the Director of the West Virginia Agricultral Experiment Station to make or cause to be made a chemical analysis of every sample of commercial fertilizer so furnished him, and he shall print the result of such anaysis in the form of a label or tag. Such printed label or tag shall set forth the name of the manufacturer, the place of manufacture, the brand of the fertilizer, and the essential ingredients contained in said fertilizer, expressed in terms and manner approved by the Director, together with a certificate from the Director, setting forth that said anylsis is a true and complete analysis of the sample furnished him of such brand of fertilizer of the ingredients claimed to be contained therein. And he shall also place upon each label or tag the money value per ton of such fertilizer, computed from its composition as he may determine. The Director shall furnish such labels or tags in quantities of one hundred, or multiple thereof, to any person or company complying with this Act, and desiring to sell, offer or expose for sale, any commercial fertilizer in this State, and shall receive therefor the sum of fifty cents for every one hundred so delivered, and shall without delay pay the same to the Treasurer of the West Virginia University for the use of the Agricultural Experiment Station, and take duplicate receipts therefor, one of which he shall retain and the other he shall deliver to

the Secretary of the Board of Regents, who shall file and preserve the same in his office.

7. The Board of Regents of the West Virginia University shall expend the money received under the provisions of this Act in meeting the legitimate expenses of the Station, in making analyses of fertilizers, in experimental tests of the same, and in such other experimental work and purchases as shall inure to the benefit of of the farmers of this State, and shall include in their annual report a statement of the receipts and disbursements thereof,

8. The Directors of said Experiment Station is hereby authorized in person or by deputy to take samples from any lot or from any commercial fertilizer which may be in the possession of any dealer in the State. And he is hereby authorized to prescribe and enforce such rules and regulations as he may deem necessary to carry fully into effect the true intent and meaning of this act; and any agriculturalist, a purchaser of any commercial fertilizer in this State, may take a sample of the same under the rules and regulations of the Director of the said Experimental Station, or forward the same to the Experimental Station for analysis, and if the Director has reason to believe that the manufacturer of, or dealer in, said fertilizer has made any false or fraudulent representation in regard to said fertilizer, he shall cause the said sample to be analyzed free of charge, and certify the same to the person forwarding the sample.

9 Said Director shall also publish, by bulletin, the brand, name and location of the manufacturer, and chemical analysis of every fertilizer analyzed or caused to be analyzed by him. Said last publication to be made, if practicable, before the time at which said fertilizer is to be applied to the soil

10. Any manufacturer or vendor of any chemical fertilizer who shall sell, or offer or expose for sale, any commercial fertilizer without having previously complied with the provisions of this act hereinbefore set forth, shall be deemed guilty of a misdemeanor, and upon conviction thereof, shall be fined not less than fifty nor more than five hundred dollars.

11. Any company, firm or person who shall wilfully remove from or deface or change any label, or tag, or brand affixed to any package or fertililer under the provisions of this act, before such fertilizer has been used for manurial purposes, or who shall sell such fertilizer without such label or tag being affixed thereto at the time of the sale, shall be deemed guilty of a misdemeanor, and upon conviction thereof, shall be fined not less than ten nor more than fifty dollars for each offense.

12. Any company, firm or person who shall remove from or cause to be removed from any package of commercial fertilizer any statement, label or tag affixed thereto under the provisions of this act, and affix or cause the same to be affixed to any other package of commercial fertilizer, shall be deemed guilty of a misdemeanor, and upon conviction thereof, shall be fined not less than ten nor more than fifty dollar for each offense.

13. Any company, firm or person violating any of the provisions

of this act, or who fails to comply with the requirements of this act, shall be deemed guilty of a misdemeanor, and upon conviction thereof, shall, when no other penalty is prescribed, be fined not less than ten nor more than one hundred dollars for each offense. But this act shall not be construed to apply to any one who manufactures fertilizers for his own use and not for sale.

14. The Director of said Experiment Station shall report to the prosecuting attorney of the county wherein the offense was committed, all violations of the provisions of this act, and failure to comply therewith, and a copy of any statement, label or tag required to be filed with said Director, or prepared by him, and any analysis made or caused to be made by him, when duly certified by said Director, shall be received in evidence in any prosecution or a suit for any violation of the provisions of this act.

15. That chapter 25 of the Acts of the Legislature of West Virgsnia, passed on the 4th day of March, 1879, entitled "An act to protect the purchasers of fertilizers in this State," be and the same is hereby repealed.

Directions for Taking Samples of Fertilizers for Analysis.

1st. All analytical work is based upon the supposition that the chemist receives a fair sample for analysis and all persons should exercise special care in securing an average, fair sample, which may best be accomplished—

(*A*) *If from bulk*—

By taking a shovel or scoop full from a number of places in the pile and rapidly and thoroughly mixing these quantities together, then taking the sample from this mixed mass. The mixing may be done upon a clean floor with the shovel or scoop by repeatedly shoveling the heaps together after separating it into several parts. The whole operation should be continuous and rapid so that there will be no appreciable change of moisture, The mixing should be sufficient to cause soft or moist masses to be broken up and thoroughly inter-mixed with the body of the fertilizer, but care should be observed not to pulverize hard dry lumps so as to change the physical character of the fertilizer. In other words the chemist should receive a fair sample both as to chemical and physical properties.

(*B*) *If from barrels, sacks or packages.*

By opening the sack, barrel or package and thoroughly mixing the contents down to about one-half of its depth by means of a shovel or scoop, then if need be withdrawing several scoops full and thoroughly mixing upon a floor exactly as under "*A*." It is best to take scoops or shovels full from several sacks or packages and mix

these as directed, then take the same for analysis from the mixed mass. Observe the conditions given under "*A*." Fair samples are best secured from fresh packages, and *farmers will do well to draw all samples immediately after purchasing*.

2nd. Care should be observed to attend to the drawing of the sample without delay and sample should be promptly selected, labeled and shipped. In the case of a manufacturer or dealer this sample is accompanied by the affidavit required by law (see directions to manufacturers). If the sample be sent by a farmer, for mutual protection, *it is best, though not required*, that it be drawn and sealed in the presence of a disinterested party who should join the farmer in certifying that the sample fairly represents the goods as purchased by him. In the *case of the farmer there is no charge for the analysis*, but the *express charges upon the sample should be prepaid*. Proper blanks will be provided by the Director free of charge for all farmers applying for them.

Instructions to Manufacturers and General Agents.

Manufacturers of Commercial Fertilizers, selling their goods in this State, will please observe the following points in complying with the Acts of the Legislature of West Virginia, passed March 6th, 1891, and now in force:

1st. A compliance with the law requires that before any commercial fertilizer is sold, offered or exposed for sale in this State, the manufacturer, importer or party who causes it to be sold, exposed or offered for sale, shall file an affidavit with the Director of the West Virginia Agricultural Experiment Station, at Morgantown, W. Va., giving a correct statement of the net pounds in the packages, the name of the brand or trade-mark under which the fertilizer is sold, the name and address of the manufacturer, the place of manufacture, and the chemical analysis stating the percentage of nitrogen, or its equivalent in amonia, the percentage of potash soluble in distilled water, and the precentage of phosphoric acid in available form, soluble in distilled water, and reverted, as well as the total phosphoric acid. In the case of those fertilizers which consist of other cheaper materials, the affidavit shall give a correct general statement of the composition and ingredients of the elements in the fertilizer relied upon to produce fertilizing effect upon the soil.

*2d The manufacturer is required to send with the affidavit a fair sample of the fertilizer in a sealed jar, bottle or tin can for analysis. An ordinary quart fruit jar or can filled with a fair sample of the fertilizer will answer. Each can or jar should be properly sealed, labeled and packed, and shipped prepaid by express to Dr. John A. Myers, Morgantown, W Va.

3d. The manufacturer is required to pay at the time of filing the

*Manufacturers will please keep a sample of the same lot for analysis by their own chemist

affidavit an analysis fee of $10 for each and every fertilizer ingredient claimed by him. If he claims potash, phosphoric acid and nitrogen, it is $10 for each, or $30 for a complete fertilizer, consisting of all three of the above named elements of plant food. This fee should be sent in a draft upon New York or Baltimore, payable to "The Treasurer of the West Virginia University."

4th. The manufacturer is required to place a label or tag upon each package, giving the name of the brand, its correct net weight, analysis and commercial valuation per ton. These labels are provided only by the Director of the West Virginia Agricultural Experiment Station, are regularly numbered and can only be had by the parties filing the affidavit before mentioned. The law establishes the price at 50 cents per 100 labels or tags. Manufacturers requiring these tags or labels should indicate to the Director the number of each kind required, and send a check payable to John A. Myers, Director, for the amount. They will be sold in packages of 100 each, and manufacturers will please order by even hundreds.

Manufacturers and agents will therefore please to take immediate steps to comply with the above indicated provisions, which are intended to guide them. The Director will furnish the necessary blanks for complying with the law, free of charge, and will aid the manufacturers in any way in his power to comply with its requirements. All affidavits and applications for labels should be filed as soon as possible.

Address all communications to

DR. JOHN A. MYERS,
Morgantown, West Va.

Samples received at the Experiment Station from Manufacturers will be analyzed in the order received. *Manufacturers and dealers are, therefore urged not to wait to the last moment to send in their samples, but to send them as soon as possible.*

MANUFACTURERS' BLANK.

Blank copies of the same will be furnished by the Director free of charge upon application.

Manufacturers or dealers sending samples of Commercial Fertilizers for analysis under the "Act Concerning Commercial Fertilizers" in West Virginia, will please fill out and send with the samples the following affidavit, Addressed to Dr John A. Myers, Morgantown, W. Va.:

I, ... of .... do hereby certify that the sample of the following named Commercial Fertilizer ... sent this day by .... to Dr. John A. Myers Morgantown, W. Va., contained in ......, correctly labelled and securely sealed, for analysis under the Act of the Legislature of West Virginia, "Concerning Commercial Fertilizers," to the best of my knowledge and belief truly and fairly represents the chemical composition of the fertilizer as manufactured and offered for sale by us in the State of West Virginia. The manufacturers guarantee the following minimum analysis:

	Name and trade mark of fertilizer	Manufacturers name and address	Name and address of sender	Minimum per cent. of nitrogen guaranteed	Minimum per cent of soluble phosphoric acid guaranteed	Minimum per cent. of reverted phosphoric acid guaranteed	Minimum per cent. of available phosphoric acid guaranteed.	Minimum per cent of total phosphoric acid guaranteed	Minimum per cent. of potash guaranteed	Minimum net weight of package guaranteed.
1										
2										
3										
4										
5										
6										
7										
8										

Given under my hand and seal this ....day of..... ...., 189... *Signed* ....

I, ..., a notary public within and for the county of .... State of .... do hereby certify that the above statement was sworn to before me by .... of .... on this ....day of ...., 189....

Given under my hand and official seal as Notary Public, this ....day of ....189....

NOTARY SEAL.

....

Notary Public

FARMERS' BLANK.

The following blank is supplied to farmers, free of charge, who may wish to submit samples under section 8 of the Act:

Farmers sending samples of fertilizers for analysis under the Act of the Legislature of West Virginia, passed March 6th, 1891, will please fill out and send the following blank by mail to Dr. John A Myers, Morgantown, W. Va.:

I hereby certify that the sample of fertilizer known and sold as

....
(Name of Brand.)

was bought by me of ....
(Dealer's Name and Address.)

West Virginia, ... and that it rep-
Date of Purchase

resents fairly the quality of the fertilizer as delivered to me. The fertilizer is guaranteed by the manufacturer to have the following chemical composition:

....
(Copy the Analysis.)

....

....

....

....

It is sold at $......per ton cash or $......per ton upon time. The Director's tag taken from one of the packages is enclosed with the sample.

Sign ....

Date, ..., 189

Address, ...

I hereby certify that I witnessed the taking of the above named sample by ...., and that I believe it represents fairly the quality of fertilizer bought by him, and sampled for analysis. I further state that I have no financial interest in the above transaction.

Sign, ...
(Name of some other person.)

Date, ..., 189..

Address, ...

NOTICE.—Farmers and others in taking samples for Analysis will please follow closely the directions given for sampling fertilizers.

JOHN A. MYERS, *Director.*

TABLE · Showing the Chemical Analyses and Guaranteed Composition, Together with Relative Commercial Values of All of the Brands of Fertilizers Sold in West Virginia During the Year 1893.

Analyses by DR RUDOLPH J. J. DE ROODE, Chemist, West Virginia Agricultural Experiment Station.

NAME OF BONE.	NAME AND ADDRESS OF MANUFACTURERS OR GENERAL AGENTS	Total Phos. Acid. Per Cent	Sol. Phos. Acid Per Cent	Rev. Phos. Acid Per Cent	Avail. Phos. Acid Per Cent	Insol. Phos. Acid Per Cent	Nitrogen Per Cent	Potash Per Cent	Value per ton by our Analysis	Value per ton by Manufacturer	Total Phos. Acid Per Cent	Avail. Phos. Acid Per Cent	Nitrogen Per Cent	Potash Per Cent	Excess of Values by Analysis	Deficiency by Analysis, showing Shortage
Star Brand Tobacco Manure	Allison & Addison, Richmond, Va	12.32										9.00				
Star Brand Guano	Allison & Addison, Richmond, Va	10.12										8.00				
Anchor Brand Tobacco Fertilizer	Allison & Addison, Richmond, Va	12.05														
Acid Phosphate	Allison & Addison, Richmond, Va	14.45	9.51									13.00				
Bone and Blood	Amour & Co., Chicago, Ill	13.03														
Bone Meal	Amour & Co., Chicago, Ill	26.67														
Dissolved Bone	Amour & Co., Chicago, Ill	13.29														
Quick Acting Bone	Amour & Co., Chicago, Ill	21.09														
Pure Raw Bone Meal	Baugh & Sons, Baltimore, Md	22.79														
Pure Diss. Raw Bones	Baugh & Sons, Baltimore, Md	18.13	1.82		13.30							10.00				
Double Eagle Phosphate	Baugh & Sons, Baltimore, Md	12.45	6.42		9.10							8.00				
Dissolved S. C. Rock or Acid Phosphate	Baugh & Sons, Baltimore, Md	15.88			11.98							13.00				
Soluble Alkaline Superphosphate	Baugh & Sons, Baltimore, Md	12.83										10.00				
High Grade Super Phosphate of Bone	D. Blocher & Co., Pennsylvania	14.00			10.93	3.07						9.00				
Va. Soluble Bone Phosphate	D. Blocher & Co., Pennsylvania	11.10	6.16			2.95						7.00				
	Atlantic & Virginia Fertilizing Co., Richmond, Va	12.30			9.19	3.11						8.00				
Eureka B. & P. Compound	Atlantic & Virginia Fertilizing Co., Richmond, Va	15.26	8.00		11.49	3.87						10.00				
Fine Ground Bone	Cincinnati Dessicating Co., Cincinnati, Ohio															
Pure Acidulated Bone	Cincinnati Dessicating Co., Cincinnati, Ohio	18.67										10.00				
Gilead Phosphate	Cincinnati Dessicating Co., Cincinnati, Ohio	13.10	3.31									10.00				
Ohio Valley Phosphate	Cincinnati Dessicating Co., Cincinnati, Ohio	12.84	2.18									8.00				
Phoenix Phosphate	Cincinnati Dessicating Co., Cincinnati, Ohio	10.67	3.12	5.13	8.25	2.42						8.00				
Superior Bone	The Cleveland Dryer Co., Cleveland, Ohio	23.74														
Square Bone	The Cleveland Dryer Co., Cleveland, Ohio	22.31	4.55	7.76	12.31	10.00						6.00				
Ohio Seed Maker	The Cleveland Dryer Co., Cleveland, Ohio	14.42	6.46	5.00	11.46							10.00				
Buckeye Ammoniated Bone Super Phosphate	The Cleveland Dryer Co., Cleveland, Ohio	16.71	6.79	6.51	13.27							9.00				
	The Cleveland Dryer Co., Cleveland, Ohio	17.83	8.97	5.90	14.87							13.00				
Potato Manure	Chemical Company of Canton, Baltimore, Md	10.42	6.21	2.81	9.05							8.00				
Pure Dis'd S. C. Bone	Chemical Company of Canton, Baltimore, Md	16.78	12.90	2.44	15.34							13.00				
Baker's Special Wheat and Corn and Grass Mix.	Chemical Company of Canton, Baltimore, Md	12.16	8.75	1.91	10.66							9.00				
	The Chesapeake Guano Co., Baltimore, Md	11.43	7.65	2.00	9.65							11.00				
Corn and Oats Fertilizer	The Chesapeake Guano Co., Baltimore, Md	11.13										9.00				
Dissolved Bone Phosphate	The Chesapeake Guano Co., Baltimore, Md	14.78										13.00				
	Detrick Fertilizer and Chemical Co., Baltimore, Md.	12.13										10.00				
Durham Ammoniated Fertilizer	Durham Fertilizer Co., Durham, N. C.	10.22										8.00				
Durham with Peruvian	Durham Fertilizer Co., Durham, N. C.	10.19										8.00				
N. C. Aliance Official Guano	Durham Fertilizer Co., Durham, N. C.	10.23										8.00				
King's S. C. Bone	Evan King, Pisgah, W. Va.	16.43										13.00				
Keystone Diss. Bone Phosphate	S. M. Hess & Bro., Philadelphia, Pa											8.00				
Emperor Phosphate	S. M. Hess & Bro., Philadelphia, Pa	13.54	9.76	3.26	13.05	0.49						10.00				
Special Home Mixture and Bone Phos.	W. F. & T. P. Lippitt, Charles Town, W. Va	11.15	7.47	2.48	9.93							8.00				
Standard	Lister's Agri. Chem. Works, Newark, N. J.	12.18	7.78	1.20	8.98							10.00				
Harvest Queen	Lister's Agri. Chem. Works, Newark, N. J.	11.41	6.10	2.03	8.13											
U. S. Phosphate	Lister's Agri. Chem. Works, Newark, N. J.	10.12	4.25	2.63	6.88											
Ruth's Good Luck Guano	Lorentz & Rittler, Baltimore, Md	9.74	5.97	2.17	8.14											
Ammoniated Bone	Maryland Fertilizer & Mfg. Co., Baltimore, Md	11.71	6.46	1.99	8.45											
Globe Compl'ete Manure	Maryland Fertilizer & Mfg. Co., Baltimore, Md	12.50	6.47	2.27	8.74											
Tornado Fertilizer	Maryland Fertilizer & Mfg. Co., Baltimore, Md	12.52	9.06	2.54	11.60							11.00				
Linden Superphosphate	Maryland Fertilizer & Mfg. Co., Baltimore, Md	12.15	7.06	3.41	10.47	1.68						10.00				
Dissolved Phosphate	Maryland Fertilizer & Mfg. Co., Baltimore, Md	15.89			11.82	1.07						13.00				
Dissolved S. C. Bone	Maryland Fertilizer & Mfg. Co., Baltimore, Md	15.91			14.83	1.08						12.00				
P. G. Ammoniated Super Phosphate	The Mt. Airy Manufacturing Co., Baltimore, Md	9.66														
Piedmont Pure Raw Bone Mixture	The Mt. Airy Manufacturing Co., Baltimore, Md	10.70														
Piedmont Dissolved Bone Phosphate	The Mt. Airy Manufacturing Co., Baltimore, Md	11.95			11.08	0.87										
	The Mapes Formula and Peruvian Guano Co., Newark, N. J.	9.94														
Fine Raw Bone	N. W. Fertilizing Co., Chicago, Ill	22.87														
Garden City Super Phosphate	N. W. Fertilizing Co., Chicago, Ill	14.12										8.00				
Prairie Phosphate	N. W. Fertilizing Co., Chicago, Ill	11.64										6.00				
Alliance Phosphate	Offutt & Lakin, Terra Alta, W. Va	8.18	5.89	1.77	7.66	0.52										
Farmer's Standard Ammoniated Phosphate	G. Ober & Sons, Baltimore, Md	15.15	7.28	5.54	12.82	2.33						8.00				
Ober's Special Amm'd Diss. Bone	G. Ober & Sons, Baltimore, Md	11.00	8.32	4.30	12.62	1.38						8.00				
Ober's Diss. Bone Phosphate S. Ca	G. Ober & Sons, Baltimore, Md	17.54	11.74	2.95	14.69	2.85										
A. B. Phosphate	G. Ober & Sons, Baltimore, Md	13.08	7.61	3.70	11.31	1.77										
Red Bag Fertilizer, Powell's	W. S. Powell & Co., Baltimore, Md	7.31	1.85	4.18	6.03	1.28										
Bone and Potash, Powell's	W. S. Powell & Co., Baltimore, Md				12.00											
Preferred Chemicals for Composting	W. S. Powell & Co., Baltimore, Md															
Ral'in's Acid Phosphate or Diss. S. C. Bone	The Raisin Fertilizing Company, Baltimore, Md			2.52	15.36	0.71										
Dissolved Bone	The Raisin Fertilizing Company, Baltimore, Md	13.92	9.78	2.01	11.79							10.00				
Empire Guano	The Raisin Fertilizing Company, Baltimore, Md	11.73	7.42	1.94	9.36	2.37						8.00				
Walker Diss. S. C. Phosphate	The Raisin Fertilizing Company, Baltimore, Md	15.92			15.28							11.00				
Diss. South Carolina	Shinghuff & Co., Baltimore, Md	15.58	12.78	1.91								12.11				
Universal Super Phosphate	Shinghuff & Co., Baltimore, Md	10.84										8.00				
Ammoniated Bone	Shinghuff & Co., Baltimore, Md	10.11										8.00				
"Silzer Gray"	The Wooldridge Fertilizer Co., Baltimore, Md	11.63										3.50				
"Kangaroo Komplete Kompound	The Wooldridge Fertilizer Co., Baltimore, Md	10.98										5.25				
"National" Tobacco Fertilizer	S. W. Travers & Co., Richmond, Va	9.65										8.50				
"Beef Blood and Bone" Fertilizer	S. W. Travers & Co., Richmond, Va	9.46										8.00				
"Standard" S. C. Bone	S. W. Travers & Co., Richmond, Va	14.78										13.00				
"Capital" Diss. S. C. Bone	S. W. Travers & Co., Richmond, Va	10.93										10.00				
Normal Bone Phosphate	I. P. Thomas & Son Co., Philadelphia, Pa	11.06										8.50				
Farmer's Choice Bone Phosphate	I. P. Thomas & Son Co., Philadelphia, Pa	11.74										9.50				
Improved Super Phosphate	I. P. Thomas & Son Co., Philadelphia, Pa	14.51			13.30							12.00				
S. C. Phosphate	I. P. Thomas & Son Co., Philadelphia, Pa	16.11	11.04	3.00	14.04							3.00				
"Pigs Foot" Brand Chicago Bone Meal	Thompson & Edwards Fertilizer Co., Chicago, Ill	20.61			7.04							8.00				
Pure Raw Bone	Walker, Stratman & Co., Pittsburg, Pa	22.70						3.47								
Potato Special	Walker, Stratman & Co., Pittsburg, Pa	13.13	6.36	2.59	8.95	4.48	1.70	1.67				10.00				
Big Bonanza	Walker, Stratman & Co., Pittsburg, Pa	15.48	7.23	3.00	10.23	5.25	2.05	1.02				10.00				
Four Fold	Walker, Stratman & Co., Pittsburg, Pa	13.61	6.60	2.80	9.40	4.21	1.68	3.93				8.00				
Help Mate	Walker, Stratman & Co., Pittsburg, Pa	15.86	13.72	1.65	15.37	0.49						12.00				
Zell's Economizer	The Zell Guano Co., Baltimore, Md.	12.41	8.87	2.05	10.92	1.49						9.00				
Zell's Calvert Guano	The Zell Guano Co., Baltimore, Md.	12.45	8.82	2.27	11.09	1.36						9.00				
Ze l's Diss. Bone Phosphate	The Zell Guano Co., Baltimore, Md.	16.72	12.44	2.20	14.64	2.08						13.00				
Reed, Long & Manning's XXV Bone Phosphate	Susquehanna Fertilizer Co.	10.56	6.51	1.36	8.87	1.69						8.00				
Miller's Standard Amm'd Bone Phosphate	Susquehanna Fertilizer Co.	10.60	6.45	2.55	9.00							8.00				
Farmer's new Method	Detrick Fertilizer & Chemical Co., Baltimore, Md	12.65	6.93	3.03	9.96	2.69						8.00				
Detrick Wheat Fertilizer	Detrick Fertilizer & Chemical Co., Baltimore, Md	11.00	8.97	3.37	12.34	1.68	1.01					10.00				
Dissolved South Carolina Bone	Detrick Fertilizer & Chemical Co., Baltimore, Md	15.52	12.27	2.28	14.55	.97						14.00				
Soluble Bone Phosphate and Potash	Detrick Fertilizer & Chemical Co., Baltimore, Md.	14.48	10.01	3.51	13.52	.96		2.81				10.00				
High Grade Soluble S. C. Phosphate	Hubbard & Co., Baltimore, Md	16.15			14.09	2.06						14.00				
Dissolved S. C. Bone	Susquehanna Fertilizer Co., Baltimore, Md	16.18	12.61	2.01	14.62	1.56						13.00				
Zell's Pure Ground Raw Bone	The Zell Guano Co., Baltimore, Md	22.77														
Zell's Dissolved S. C. Bone	The Zell Guano Co., Baltimore, Md	15.80	12.54	1.84	14.38	1.42						11.00				
Zell's Dissolved S. C. Phosphate	The Zell Guano Co., Baltimore, Md	13.25			12.63							12.00				
Pure Fine Ground Bone	Maryland Fertilizer & Manufacturing Co., Baltimore, Md.	23.08														
Special Mixture for Wheat	G. Ober & Sons Co., Baltimore, Md	13.09	8.09	2.60	10.69	2.40						8.00				
Shenandoah Bone Phosphate	G. Ober & Sons Co., Baltimore, Md	15.31	6.94	3.37	10.31							9.50				
Mt. Airy S. C. Bone Phosphate	Mt. Airy Manufacturing Co., Baltimore, Md.	15.13	11.84	2.16	14.00							13.00				
High Grade Fish Guano	Samson Fertilizer & Chemical Co., North-East, Pa	12.03	7.00	2.46	9.46							10.00				
Old Dominion Special Wheat Guano	Old Dominion Guano Co., Norfolk, Va	8.90	6.30	2.15	8.45							8.00				
Royster's High Grade Acid Phosphate	Old Dominion Guano Co., Norfolk, Va	13.87	7.34	5.76	13.10							12.00				
High Grade Alkaline Bone	Old Dominion Guano Co., Norfolk, Va	9.69	6.52	2.67	9.19							10.00				
Powell Dis. S. C. Bone	W. S. Powell & Co., Baltimore, Md	16.14	12.43	3.13	15.56	0.58						14.00				
Orchilla Guano	The Wooldridge Fertilizer Co., Baltimore, Md	15.41		3.20	3.20	12.21										
Ramsburg Excelsior Plant Food	Ramsburg Fertilizer Co., Frederick, Md	13.95	7.18	3.61	10.79	3.16	1.82					9.00				
Dis. Bone Super Phos	Ramsburg Fertilizer Co., Frederick, Md	15.00	7.42	1.61	12.03											
Lake Erie Fish Guano	Jarecki Chemical Co., Sandusky, O	13.51	9.91	2.70	12.61							12.00				
Urbana Super Phos. & Potash	The Loudenback Fertilizer Co., Urbana, O.	11.10										10.00				
Gehly's Dis. Bone Phos	F. H. Gehly, York, Pa	14.75	12.06		13.87							11.00				
Baugh's Fine Ground Bone with Potash	Baugh & Sons, 412 E. Lombert St., Baltimore, Md	18.18														
Plow Brand Super Phos	Walton & Whann, Wilmington, Del	11.84			8.63							9.00				
Wheat and Grass Grower	Walton & Whann, Wilmington, Del	11.13			10.96							10.00				
Reliance Am. Super Phosphate	Walton & Whann, Wilmington, Del	11.19										8.00				
High Grade Dis. Bone	Walton & Whann, Wilmington, Del											10.00				
Diamond Sol. Bone	Walton & Whann, Wilmington, Del	16.52										13.00				
Dis. Bone Phos	Walton & Whann, Wilmington, Del											12.00				
XX Acid Phos	Walton & Whann, Wilmington, Del	17.29										13.00				
Sure Growth Super Phos	Scott Fertilizer Co., Elkton, Md	11.56										9.00				
Scotts Pure Ground Bone	Scott Fertilizer Co., Elkton, Md	24.23														
Tip Top Soluble Bone	Scott Fertilizer Co., Elkton, Md	15.06	10.17	2.91	13.08											
Defiance Bone	Baltimore Guano Co., Baltimore, Md	13.01	8.44	2.68	11.12							13.00				
B. G. Am'd Bone	Baltimore Guano Co., Baltimore, Md	9.52	2.23	5.38	7.61							10.00				
Baltimore Soluble Bone	Baltimore Guano Co., Baltimore, Md	14.66	11.82	1.96	13.78							15.00				
Our Acid Phosphate	Atlantic & Virginia Fertilizer Co., Richmond, Va	14.64	7.87	3.70	11.57											
Crenshaw's Best Acid Phos	Atlantic & Virginia Fertilizer Co., Richmond, Va	16.78	9.36	3.29	12.65											
Dissolve I S. C. Bone	Lechlider Bros., Hagerstown, Md	10.01	1.92	5.14	7.06											
Superior Ground Bone	Samson Fertilizer & Chemical Co., North-East, Pa	29.23														
Shenandoah	W. F. & T. P. Lippitt, Charles Town, W. Va.	11.78	6.43	3.19	9.62	2.16	2.02	2.23				8.00				
Dissolved S. C. Bone	Sencindiver, Shaffer & Stewart, Martinsburg, W. Va	12.52	3.33	7.98	11.31	1.21						13.00				
Lee's Prepared Agr'l Lime	A. S. Lee, Richmond, Va							1.86								
High Grade Dis. S. C. Bone	Tygert-Allen Fertilizer Co., Philadelphia, Pa	16.28	11.89	2.19	14.04	2.20						14.00				
Am'd Bone Phosphate	Tygert-Allen Fertilizer Co., Philadelphia, Pa	10.19	5.55	3.07	8.62	1.57	1.04	1.30				8.00				
Soluble Bone and Potash	Tygert-Allen Fertilizer Co., Philadelphia, Pa	11.60	7.61	4.48	10.09	1.51		2.44				10.00				

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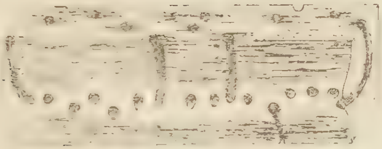
West Virginia Agricultural Experiment Station,

MORGANTOWN, W. VA.

Defects in Wood Caused by Insects.



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BULLETIN 35.

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ENTOMOLOGICAL DEPARTMENT.

VII Injurious and Other Insects of West Virginia.

4 Forest and Shade Tree Insects.

DEFECTS IN WOOD CAUSED BY INSECTS.

BY A. D. HOPKINS,

Morgantown, West Virginia.

CONTENTS.

ILLUSTRATIONS.

All of the illustrations in this Bulletin except Fig. 21 are drawn from nature by the author.

DEFECTS IN WOOD CAUSED BY INSECTS.

BY A. D. HOPKINS.

I have recently had occasion to conduct some investigations with reference to the damage caused by wood-boring insects, and to study the habits of some of the species causing the kinds of defects most frequently met with. I find that there are many different kinds of defects which are caused by as many different species of insects, some of them being very destructive or injurious to the wood, while the damage caused by others is comparatively slight. Some of the insects infest only dead trees, logs and stumps; others attack injured or unhealthy, standing trees, while still others prefer to attack the healthy wood of living ones. Certain species inhabit only the sap-wood, while others enter the sound heart-wood and perforate it with numerous holes, which may extend for several feet through the best part of the wood.

It has been ascertained that the holes produced by different kinds of wood-boring insects usually have some marked characteristics peculiar to the species, or to a class of nearly related species, and that while the common term "worm holes," used to designate these peculiar injuries, may be properly applied to some of them, and "pin holes" to others, these two common names can not be properly used for all. Therefore, in order that we may refer to the different kinds of defects caused by insects, by some simple, descriptive names, I will present the following, provisional classification and popular names.

1st. Pin Holes. Small, round holes, one-hundredth of an inch to one-fourth of an inch in diameter.

2nd. Worm Holes. Large, irregular, flattened, or oblong holes, one-fourth of an inch, or less, to one and one-half inches in diameter.

3rd. Black Holes. Rows, or single, black-lined holes about one-twelfth of an inch in diameter, accompanied by discolored streaks, or patches in the wood.

4th. Sap-wood Holes. Occuring only in sap-wood, including sap-wood pin holes, sap-wood worm holes, sap-wood black holes.

5th. Enlarged Holes. Any of the above which are enlarged by ants or other insects, or by decay.

Pin Holes in Heart-Wood *

This defect is commonly met with in Oak and Chestnut, especially in the latter. When these holes occur in a tree or piece of wood, they are usually found of various sizes, and are in large numbers within a given space. When they occur in the sound timber, they are usually lined with a substance of about the same color as that of the surrounding wood, and are seldom accompanied by discolored streaks. They are produced by small, long, round-bodied worms, which are the young form of (winged) beetles. The adults of this class of wood-boring insects place their eggs in the crevices of the bark, or in the edge of wounds in the bark or wood. The minute worms hatching from the eggs bore directly into the wood, forming at first holes so small that they are scarcely visible to the unaided eye. They do not stop in the sap-wood, as some kinds do, but extend their burrows to the heart of the tree or farther, each worm making for itself a separate burrow in which it remains until matured. The borings, excrements and surplus secretions from the wood are pushed out from the original entrance by them, as they move back and forth, which they must frequently do both for the purposes mentioned, and in order that they may each time slightly enlarge the burrows to accommodate the increasing size of their bodies. Thus the holes made by these insects are found to vary in size, and to extend several feet through the wood.

Pin Holes in Chestnut Wood.

These are familiar to every one who has handled or manufactured much of this wood, and are good examples of what are termed pin holes.

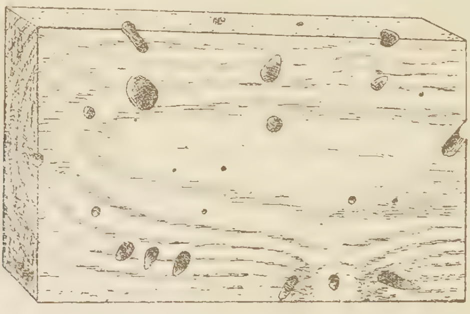

Fig. 1.—*Pin Holes in Chestnut Wood.* 1-100 to 1-4 in. in diameter.

*The term pin holes, used to designate certain kinds of holes in wood produced by insects, no doubt originated with stave makers and coopers from the fact that such holes are often plugged with small wooden pins. Augur holes in lumber, from rafted logs are, in certain localities, sometimes called pin holes, but I believe defects of this kind are more often designated by the proper name, augur holes.

The characteristic appearance of pin holes in chestnut boards is shown in Fig. 1. The insect to blame for this defect is known as the Chestnut Timber Worm. Fig. 2. The distinctive characters which will enable any one to identify this odd-looking worm are the peculiar, hood-like enlargements just back of the head, and the dark-brown, horny gouge with its toothed edge on the opposite extremity of the body. This insect infests logs, stumps and dead trees, also living trees of all sizes, but are most common in old ones, or those which have attained considerable size.

Fig 2.—*The Chestnut Timber Worm.* Body yellow; length 7-8 in., width 1-8 in.

It appears that they will not infest a living tree unless some wound in the bark or wood occurs in which the parent beetle can deposit her eggs; however, the slightest wound is sufficient to start a colony of them to work in a tree. A broken or decayed branch, or a wound in the bark of a standing tree caused by the falling of another against it, or by anything that breaks through the bark, will be sufficient to give them a start. I have found that a wound produced by a small bullet in a young, thrifty tree was sufficient to attract the parent beetle to the spot for the purpose of depositing her eggs, and that although the wound had been made ten years (ascertained by counting the annual growths), the wood at that point was still infested by the worms, thus indicating that one wound may be utilized year after year by succeeding generations of the insect. Another example observed was that of a wound in the bark and wood of a young tree six inches in diameter, caused by a load of shot, which had been the means of starting so many of the worms to work in the wood at that point, that the tree was apparently dying from the injuries.

Although it is known that the parent, or adult form of the Chestnut Timber Worm is a beetle, the exact species has not as yet been discovered. This insect is being studied, however, and I hope soon to be able to present a more complete account of the species and its destructive work, with suggestions for preventives, remedies, etc.

Pin Holes in Oak

Another example of pin holes in heart-wood is quite frequently met with in various kinds of oak, and these are familiar to most persons who have had much to do with this wood, the characteristic appearance of which is represented in Fig. 3.

Fig. 3.—*Pin Holes in Oak Heart-Wood.* 1-100 or less to 1-8 in. in diameter.

These holes are serious defects when they occur in staves, heading and lumber. They are also a serious detriment to square timber used in structures, the wood work of which is exposed to the weather.

The kinds of pin holes most common in oak heart-wood are caused by the Oak Timber Worm, Fig. 4, which has habits similar to those of the Chestnut Timber Worm. The young ones are long, slender, about the size of a small pin; hence are often called "Pin Worms." The distinctive characters of this timber worm are sufficiently represented in the illustration, Fig. 4.

Fig. 4.—*The Oak Timber Worm:* natural size and enlarged; body white; head brownish.

This insect appears to prefer logs, stumps, and trees, which have been dead or felled one or more years. They will, however, occasionally infest the perfectly sound wood of living trees, and occur quite frequently in the unsound wood of the same; but from my observation, it appears that they will not attack living trees unless there has been some previous and quite severe injury to the bark and outer sap-wood.

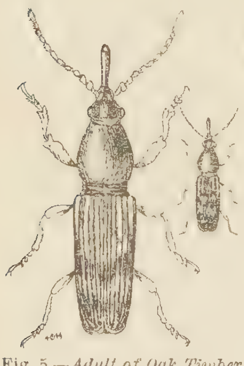

Fig. 5.—*Adult of Oak Timber Worm.* Female enlarged and natural size; reddish brown with yellowish markings.

Fig. 6.—Head of male enlarged.

The adult, or parent of the oak timber worm, is an odd-looking snout-beetle, as will be seen by reference to Figs. 5 and 6. It will be observed that the female (Fig. 5.) has a longer snout or proboscis than the male (Fig. 6.), with which she is provided, that she may puncture the bark or wood for the purpose of forming receptacles for her eggs.

Pin Holes in Sap-Wood.

There are numerous kinds of pin-holes which occur only in sap-wood. These are caused principally by a class of insects known as timber beetles, which includes a large number of species. Figs. 8, 10, 12 and 14 are good representatives of this class of insects, They are thus named on account of the habits of the adults, which bore into the wood for the purpose of excavating galleries in which their eggs may be deposited. The galleries excavated by these beetles are of two characteristic forms. Figs. 7 and 9 represent one form, the characteristic features of which are the short side or brood chambers extending from the main gallery. The parent beetles excavate the main galleries, and deposit their eggs in small cavities at more or less regular intervals along the sides. The young, as soon as hatched, proceed to enlarge and extend these cavities at right angles to the main gallery, and usually with the grain of wood, but only in proportion to the length and breadth of their bodies as they increase in size. The entrance to each of these brood chambers is kept securely sealed from the time the young are hatched until they are ready to emerge as fully matured beetles. When each adult is fully matured, it breaks through its prison door, and comes out into the main gallery through which it passes to the open air. Thus the entire brood emerges from the original entrance to the galleries in which they developed.

Fig. 7.

Fig. 8.

Fig. 7.—*Pin Holes in Sap wood:* Natural size: showing galleries and brood chambers of Fig 8.

Fig. 8.—*The Apple Timber Beetle:* Natural size and enlarged; dark brown, shining.

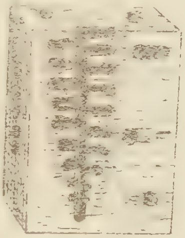

Fig. 9.

Fig. 10.

Fig. 9.—*Pin Holes in Sap wood:* Natural size: galleries and brood chambers of Fig. 10.

Fig. 10.—*The Spruce Timber Beetle:* Natural size and enlarged; some examples have black and light brown stripes on wing covers, others are plain brown.

Figs. 11 and 13 illustrate the other characteristic form of galleries adopted by quite a number of species. These are also excavated by the parent beetles, but instead of depositing their eggs in cavities in the sides of the galleries, they place them in unprotected groups within the walls. The

Fig. 11. *Black Pin Holes in Sap Wood.* Natural size; showing galleries of Fig. 12.

Fig. 12. *Stout Timber Beetle.* Male and female: natural size and enlarged; female much larger, jet black with small spines on hind edge of wing covers. Male small, light brown, without spines.

young are small, white grubs, which do not enlarge and extend the galleries, but appear to feed on a substance coming from the wood. All stages, from eggs to fully matured adults, often occur together in one main gallery. It appears that the young beetles do not necessarily emerge from the galleries in which they develop, in order to excavate new ones, but may extend secondary and branching galleries in which to deposit eggs for another brood. One marked peculiarity of most of the species inhabiting galleries of this character is the extreme small size of the male as compared with that of the female. (Figs. 12 and 14.) It appears that these small males, which are not capable of flying, never emerge from the galleries in which they develop.

Fig. 13 *Pin Holes in Sap-wood.* Natural size; sh wing galleries of Fig. 14.

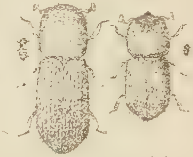

Fig 14. *The Hairy Timber Beetle.* Male and female, natural size and enlarged, female larger, light brown, covered with hairs, a few small tubercles on hinder part of wing covers. Male smaller, light brown, with depression and a small spine in front

The holes produced in wood by each species of timber beetles are always more or less uniform in size from the fact that, as the adults do the excavating, their burrows are only just large enough to allow them to pass freely back and forth.

Nearly all of the valuable kinds of wood are infested by one or more species of these timber beetles, but as a rule they enter only the wood of diseased, dying or felled trees. Most of them prefer to enter the wood immediately after the sap ceases to flow, or before the sap-wood is entirely dead.

Stumps, saw logs and trees, cut during the winter and early spring and allowed to remain with the bark on through the spring and summer months, offer the best conditions for the development and increase of this class of insects, and the sap-wood of certain kinds of timber thus neglected is usually thickly perforated with their galleries.

Sap-Wood Timber Worm.

Fig. 16 represents another characteristic form of sap-wood pin holes frequently met with in saw logs and dying trees of different kinds. This is the work of an odd-looking worm, the distinctive characters of which are sufficiently illustrated in Fig. 17, to enable any one to readily recognize it. I have reared the adults of this insect, and find that the worms remain in the burrows through the winter, and that the adult (Fig. 18) emerges in April and soon after the females deposit their eggs for another brood. It appears from my observation, that the beetle will not deposit her eggs on, or in logs from which the bark has been removed, but chooses for this purpose only those with the bark on. Felled trees and saw logs cut during the fall, winter and early spring months and allowed to lie with the bark on through April, May, June and July, offer the most favorable conditions for the propagation and destructive work of this insect. The eggs are deposited in the crevices of the bark,

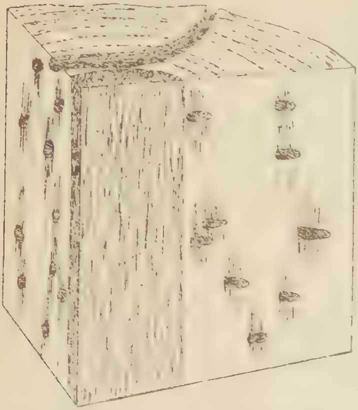

Fig. 16.—*Pin Holes in Sap-wood* by Fig 17, showing how the sap-wood is penetrated, and the heart-wood is avoided.

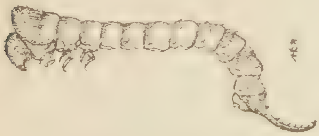

Fig. 17.—*Sap-Wood Timber Worm.* Larva of Fig. 18, enlarged; body yellow, length 3-4 in., width 1-8 in. Head and spiny tail brown.

Fig 18.—*Adult of Fig. 17.* Natural size and enlarged: head, thorax, and wing-covers, black and covered with fine hairs, abdomen and legs yellow; two prominent, feathery projections from mouth. Female with yellowish head, thorax, abdomen and legs, wing-covers black, without feathery projections from mouth

often fifteen to twenty in a single crevice. As soon as hatched, the young worms bore directly through the bark and into the sap-wood, where they proceed to the right or left and extend their burrows a foot or more across the grain of the wood. Some of them occupy the outer portion of the wood, just beneath the bark, while others extend parallel burrows at different depths between the surface and the outer heart-wood, as shown on title page and in Fig. 16. The habits of this worm in extending and enlarging the burrows are similar to those of the chestnut and oak timber worms mentioned on another page.

I have observed the kind of pin holes produced by this worm in yellow poplar, bass-wood, buckeye, chestnut, and black walnut, and have found this insect to be very destructive to the sap-wood of yellow poplar saw logs which are allowed to lie with the bark on. They often cause a total loss of from five to ten per cent.

of a log which would otherwise make first and second grade lumber. In other words, every 1,000 feet of sap-wood so affected represents a loss of from $15 to $20.

To Prevent Insect Injuries to Sap-Wood.

It has been found that nearly all of the insects which cause defects in sap-wood of logs and dying trees, attack only those with the bark on; therefore, in order to prevent these defects, it is only necessary to remove the bark before the insects deposit their eggs or enter the wood. *Take the bark from all logs and felled trees cut between October 1st and April 1st, that will have to lie more than one month after the latter date before they can be converted into lumber, and from all logs cut between April 1st and October 1st, unless they can be converted into lumber directly after the trees are felled.* By adhering to this rule, producers in this State alone will prevent depreciation in value of lumber to the amount of many thousand dollars. As a rule, the additional expense of handling logs with the bark on, over that of handling them with the bark off, will more than pay for removing it; therefore all of the timber thus protected from depreciation in value is usually so much clear gain.

Worm Holes in Heart-Wood

Fig. 19.—*Worm Holes in Heart-Wood,* (Red Oak): ¾ in. in diameter one way by 1 to 1½ inches the other; with dark lining and slight staining of the wood.

Fig. 20.—*The Carpenter Worm:* reduced; length 3 inches; width 5/8 inch; pink and white above; greenish beneath, and head shining black.

Worm holes are produced by large, wood-boring grubs, or caterpillars, (often called worms) which are the young forms of either beetles or moth. The large, irregular holes frequently met with in red oak, Fig 19, are good examples of the larger kinds of worm holes, which are frequently met with in oak and yellow locust timber. These are caused as a rule by large, wood-boring caterpillars called carpenter worms, Fig. 20, which are the young forms of "Millers" or moth like, Fig. 21.

Fig. 21 *—*The Goat Moth*: adult of Fig. 20; male, natural size; front wings grey, hind wings black and yellow.

Another class of worm holes occurring in the sap and heart-wood of different kinds of timber is caused principally by wood-boring grubs, which are often called "Sawyers." These grubs are the young of long horned beetles like that represented in Fig. 24. Common examples of holes produced by grubs of this class are met with in white pine logs and dead trees, and are caused by the "Pine Sawyer," Fig. 23, which is a good representative of this class of wood-boring grubs. This class of holes occasionally occur in heart-wood of both dead and living trees of

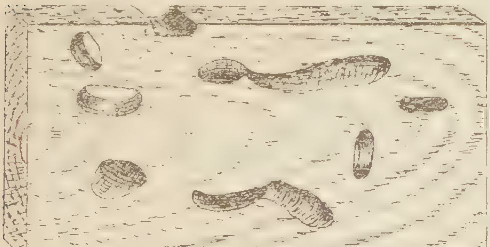

Fig 22.—*Worm Holes in Heart and Sap-wood*: caused by wood-boring grubs like Fig. 23.

Fig. 23. —*The Sawyer*: larva of Fig. 24: yellowish white with brown head.

*Stippled drawing from wood-cut by Riley.

various kinds, and are very serious detriments. They not only depreciate the value of the timber, but often render worthless that portion which would otherwise be the most valuable; especially is this so with the kind frequently met with in the heart-wood of living, yellow poplar trees, which have been injured by fire or some other cause.

Fig. 24.—"*Grey Beard*," or *Longicorn Beetle*: adult of Fig. 23: natural size; grey, with dark and light spots on wing covers

Fortunately, there are only a comparatively few species which cause worm holes in heart-wood, or at least penetrate such wood to any great distance below the sap-wood. Like the timber beetle, most of the kinds causing these defects prefer to inhabit only the sap-wood, and when such is the case, they cause what may be termed worm holes in sap-wood. Of the hundreds of species that inhabit the sap-wood, very few indeed prefer to attack that of living trees. Like the timber beetle, they nearly all infest the wood of diseased or dying trees, logs and stumps, especially trees which die in the spring, and logs which are cut in the winter and spring and allowed to lie with the bark on.

Black Holes in Wood

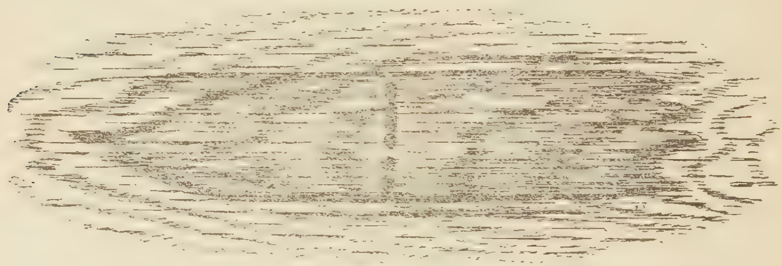

Fig. 25.—*Black Holes and Columbian Stain in White Oak:* natural size.

Black Holes in Wood is a name applied to certain characteristic black holes, which are common both in sap and heart-wood of living trees. This common defect will be the subject of our next Bulletin, (No. 36.)

Enlarged Holes in Wood.

Fig 26.—*Enlarged Holes in Wood.*

Enlarged pin holes or worm holes often occur in living and dead trees, logs, etc. In most cases, this enlargement or extension of the injuries is caused by different species of wood-infesting ants, and may be caused by them either before or after decay sets in. The characteristic appearance of these enlarged holes is represented in the above figure, where pin holes caused in red oak, evidently by the oak timber worm, have been enlarged by black ants.

Character of Loss Resulting from Insect Injuries in Wood.

The damage and loss resulting from the presence of different kinds of insect injuries in wood, may be classed under two heads as follows:

1st. Depreciation in value of otherwise sound and clear lumber and timber, causing losses to owners of timber and manufacturers of timber products.

2nd. Premature decay, resulting from the presence of the holes, which allow moisture and fungus germs to obtain lodgment in the sap and heart-wood of trees, logs and manufactured timber products, thus causing serious loss to both producers and consumers.

Amount of Losses Resulting from Insect Injuries in Wood.

The losses from depreciation in value of timber and lumber on account of insect injuries, while known to be very great, would be difficult to represent in dollars and cents, without further knowledge regarding the extent and distribution of the different kinds of defects, and the per cent. of manufactured material affected by each.

I have endeavored to obtain further information on this subject, by means of circular letters, mailed to lumber manufacturers in different sections of the country. While I have received some very satisfactory answers, containing valuable information, the replies have as yet been far too few, upon which to base satisfactory estimates. It would appear, however, from my own observation, and from such information as has been obtained by inquiry, that the proportion of manufactured timber products depreciated in value on account of insect injuries alone, may vary with different kinds of timber, and in different localities, anywhere from $2\frac{1}{2}$ to 50% of the total output, and that in some cases the depreciated value is sufficient to reduce the cash receipts of an investment below the cost of production.

When it is considered that a large per cent. of this loss can be prevented at comparatively small cost, it will be realized that the subject is well worthy of attention, and that those who suffer the loss can well afford to give some time to the answering of questions which would lead to a better knowledge of certain obscure points; especially, as they would get in return valuable information, by means of which they could add very considerably to the profits of their business.

Distribution of the Troubles.

The fact that the different species of insects which cause defects in wood have been taken or reported by entomologists, from many different sections in North America, is evidence that most of the kinds of defects mentioned in this bulletin occur in forests throughout the United States.

Methods of Combating Wood Infesting Insects.

Methods of combating wood-infesting insects and preventing loss from their injuries may be classed under three heads as follows:

1st. *Remedies.* Including methods of destroying the insects, and of checking their ravages.

2nd. *Preventives.* Including methods of repelling the insects or preventing their attack.

3rd. *Precautions.* Including methods of management of standing, felled, and manufactured timber, to prevent the increase of insect pests, and losses from their depredation.

To the above, we may add the following:—

Expedients. Including methods of utilizing to the best advantage, timber and lumber affected by defects which have already occurred, or can not be prevented.

In the application of the first method, there is little that can be accomplished, from the fact that, after wood-infesting insects once make the attack, and have entered the wood, they are securely protected from all attempts to destroy them, except perhaps that of burning or steaming the infested wood, which is not always practicable. The introduction of natural enemies to destroy them may be considered under this head, but this method can only be applied

under certain, peculiar conditions, and is not to be thought of until both the enemy and the friendly insects have been thoroughly studied.

It is upon the second methods we must rely for the successful treatment of wood-infesting insects. The old adage, "An ounce of preventive is worth a pound of cure," is even more applicable in this case than in the treatment of diseases. With a knowledge of the habits of an insect, we can usually find some simple means of preventing their attack. For example, if a given insect makes its appearance in May and June, and deposits its eggs only during these months, and only in logs with the bark on, all injuries from its attack may be easily prevented by simply not allowing logs to lie with the bark on during the months mentioned. Many thousand dollars worth of timber can be annually saved by such methods if intelligently applied.

In regard to precautionary methods, we may mention the destruction by fire of useless material, which would favor the breeding and increase of destructive species. The proper time of year in which to fell timber is also a very important question to consider, since it is a well known fact, that trees felled in certain months, will lie for years without being infested by insects, while the same kind of tree, felled during other months, will be "literally eaten up" in a single season.* This is from the fact that trees cut just before certain insects make their appearance to deposit eggs, will offer the most favorable conditions for attack, while trees felled just after the egg-depositing period is passed, will be free from their attack during that year, and by the next the conditions of the wood and bark will be objectionable to them.

One of the most important precautions to be considered by owners and producers, is that of reporting to the Entomologist the appearance of a new pest, or a new injury of a threatening character as soon after it is observed as possible, since immense loss can often be prevented by the prompt application of the proper remedy. The invasion of a new insect pest is often to be compared to that of a conflagration, which at first may be easily extinguished, but if neglected, only for a short time, can not be controlled by the best equipped fire company.

In regard to methods of making the best possible use of defective timber and lumber, we may say that they are by no means the least important, since much loss on account of depreciation in value can be prevented, by manufacturing affected timber into dimensions suitable for uses where the defects would be the least detrimental; also into material, the value of which would be depreciated least on account of the defects. The use of defective material in manufactured articles and wooden structures, where it would be the least objectionable or detrimental, and the treatment of defects with substances to prevent decay, are also to be considered.

*This remarkable difference is attributed by many persons to the effect of the moon, and so positive are some lumbermen that this is a fact, that it is useless to argue with them to the contrary.

After all, little can be accomplished toward effective measures, by those who suffer the loss, unless they take sufficient interest in the subject of scientific research to inform themselves on some general facts relating to insect life, which is necessary in order to adopt and intelligently apply the proper and most effective methods.

It is a well-known fact that for a physician to successfully treat a disease, he must first study the symptoms and peculiar character of the complaint, and determine what the disease is; after which, if it is one that can be cured, he knows, or is supposed to know just what kind of medicine to administer. It is much the same with regard to methods of combating insect foes. We must first determine the species of insect to blame for a given trouble, then, if it is one whose life history is well known, as for instance where and when the eggs are deposited, the habits of the young, how long it takes them to develop, when the adult form emerges from the wood, how many broods there are in a season, how and where the insect passes the winter, etc., we then know the weakest point and can tell just what method will prove most effective. On the other hand, if it is an insect of which very little is known, we must study its habits, in order to determine the best method of destroying or repelling it.

Persons who have not given the subject special attention have little idea what a difficult and complicated matter it is to study and become familiar with the life history and habits of an insect, even of the commonest kind, so many and varied are the forms and habits of a single species during its life from the egg to the adult. Of all the insect pests, which the entomologist finds it necessary to investigate, there are none perhaps so difficult to study as those which inhabit the bark and wood of trees, hidden as they are during the greater part of their lives beneath the surface. Hence, comparatively few species possessing this habit have been thoroughly studied, and there remain, no doubt, many hundreds of species yet to be discovered. It is encouraging, however, to know that of those which have been studied and their habits determined, some simple means have been found to lessen the damage and loss caused by them, and in many cases to entirely prevent their destructive work, with but little expense.

It is not to be supposed that every one is to undertake the difficult task of studying the life history of insects destructive to their property. At the same time it is of the greatest importance that every one who suffers loss from insect pests, should obtain some general information regarding the different kinds, and should observe their habits, as far as possible.* Very often the observations of those who have only a slight knowledge of the subject, if reported to the entomologist, may lead to important discoveries regarding the obscure habits of an insect, or to new methods of repelling and destroying it.

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*Those who may desire to know what has heretofore been published regarding the principal forest tree pests, we would refer to the Fifth Report of U. S. Entomological Commission by Dr. A. S. Packard, issued by the Dep't of Agriculture.

In the limited pages of this bulletin, it has been possible to refer only in a general way to the principal defects in wood caused by insects. We trust, however, that it contains sufficient information to give some idea of the true character of the injuries, the kinds of insects causing them, the loss resulting from their presence in timber products, and methods of combating them. We also trust that its contents will call the attention of our readers who suffer loss from insect depredation, to the importance of having further information upon the subject; that it will lead them to make more critical observations with reference to the different kinds of injuries, and the prevalence of each in their respective localities, and that it will induce them to report promptly to us any unusual occurrence of a insect or insect injury, together with specimens of the same. Thus we will be enabled to give, in addition to replies by letter, in future bulletins the fullest accounts of those insects and injuries which are of the most importance.

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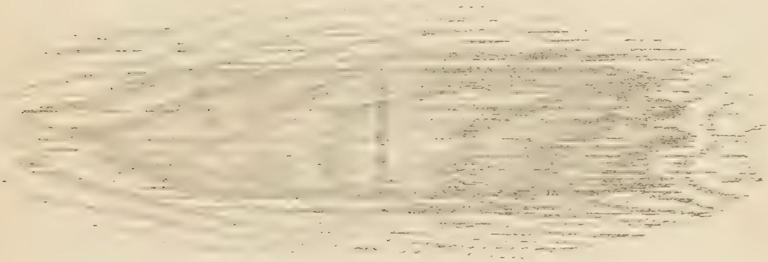
BULLETIN 36.

West Virginia Agricultural Experiment Station.

MORGANTOWN, W. VA.

BLACK HOLES IN WOOD.



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WEST VIRGINIA

Agricultural Experiment Station

BULLETIN 36.

Vol III. FEBRUARY 1894. No. 12

ENTOMOLOGICAL DEPARTMENT.

VIII Injurious and Other Insects of West Virginia

5 Forest and Shade Tree Insects.

BLACK HOLES IN WOOD

By A. D. Hopkins,

Morgantown, West Virginia

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ILLUSTRATIONS.

All of the Figures in this Bulletin are original.

*Figs. 1-26 are in Bulletin 35.
†Plate 1 is in Bulletin 16; first bulletin on Forest and Shade Tree Insects.

BLACK HOLES IN WOOD.

BY A. D. HOPKINS.

Certain characteristic, black holes in the wood of oak, poplar, beech, birch, etc. are of such common occurrence that every one who has had much occasion to handle these woods, is no doubt familiar with the defects. They usually occur in the best part of the wood either one in a place or two, or more in a row, and are always accompanied by discolored patches or streaks, as shown in the illustrations on title page.

This defect is so prevalent in white oak and certain other oaks, that it is often difficult to find a tree the wood of which is entirely free from it. In looking over a large lot of ordinary oak lumber, one can scarcely find a piece which does not show one or more of the characteristic, black holes with their accompanying discolored streaks.

In Yellow Poplar (Tulip Tree or White Wood) the same kind of defects are found, but not so commonly as in oak. When they do occur, however, in this timber the resulting damage is far greater than in oak. What is locally known as "Calico Poplar," a common and serious defect in poplar lumber from certain localities is the result of the presence of these holes. I have also observed the same trouble in beech, birch, basswood, maple and elm in this State, and elm and oak from Michigan.

The Cause Heretofore Unknown.

The real cause of this defect has, I have every reason to believe, been heretofore unknown, or at least nothing so far as I can learn has ever been published on the subject. The general supposition among those who are most familiar with it is that the holes are produced by worms; hence they are almost universally called worm holes.

My earliest recollection of insect injuries to timber is that of these black holes in wood. I remember when a boy watching the operation of riving clapboards and staves, that many of the pieces were thrown aside on account of "worm holes," as they were then called. Since I have been studying the habits of wood infesting insects, in recent years, I have noted the peculiar character of this injury, and the effect on the adjoining wood. While I was convinced that the holes were produced by a beetle belonging to a class of insects known as timber beetles, I failed until recently to meet with the culprit within its burrows. Hence, the species to blame for the trouble, and why the holes occurred so deep in the heart-wood, had until then been a mystery. The fact that some of the holes were found near the heart-wood of large trees indicated that the species causing the trouble must have different habits from any of the timber beetles known to me. The mystery regarding the cause of these peculiar black holes, and why they occurred in the best part of the tree was made plain enough when, on October 7, 1893, while conducting investigations in Randolph county, West Virginia. I discovered the insect within its burrows in the sap-wood

of living vigorous white oak and chestnut-oak trees. The discovery led to further research regarding the habits of the species, the character of the injuries, etc., resulting in the development of a number of new and very interesting facts. Among them, we may mention the following:

That species of the family, to which this one belongs, attack vigorous healthy trees has been doubted by some good authorities on entomological questions. I find that this species will enter the wood of the most vigorous trees for the purpose of excavating galleries and brood chambers, and that a brood of young will develop in the same, while the tree is in a vigorous growing condition. This fact, together with my observation on the habits of the destructive Pine Bark Beetle, which belongs to the same family, is conclusive evidence to me, at least, that two species, one a bark beetle, the other a timber beetle, will attack and breed in vigorous growing trees, and that they appear to do so through preference.

Another interesting fact regarding the black holes and the accompanying stains in the wood is, that by counting the annual rings formed over them we are enabled, perhaps, to record the earliest date of insect injuries in America. I have found black holes in oak logs that I am able to state, with a positive degree of accuracy, were excavated in 1753. I have also found the characteristic stains in the end of yellow poplar logs dating back to 1693 in one log, and to 1479 in another, the latter having been made 13 years before Columbus discovered America.

I have evidence that the insect recently discovered, or one having the same habits, was not uncommon at these early dates, and that it has been more or less common in our forests up to the present time. Yet the insect that we have found to be the cause of this peculiar defect is a new or undescribed species.

A New or Undescribed Species.

Fig 27.—*The Columbian Timber Beetle.* Enlarged and natural size; shining black, with rust-colored legs and antennæ

I have given the common name, Columbian Timber Beetle and the scientific name *Carthylus Columbianus* to this interesting new species, and will here give a popular description of it.* The adult

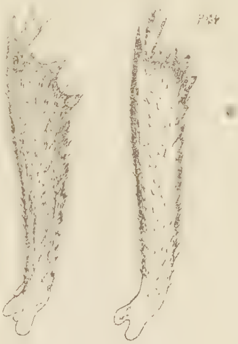
*A technical description of this species was read before the Entomological Society of Washington, D. C., on Dec. 7th, 1893, and will be published in the Proceedings of the Society,

Figs. 27 and 28, is $\frac{1}{6}$ of an inch long and 1–16 of an inch wide. The body is shining black above and below, with rust-colored legs and antennae (the small objects projecting from the side of the head). Like most species to which it belongs (See Figs. 8, 10, 12 and 14, Bulletin 35), its body is divided across the middle, thus having the appearance of possessing a head nearly or quite as large as the remainder of the body. The head, however, is not observed from above, but is plainly visible from the sides, as in Fig. 28. Thus it will be seen that this species, like all other insects has its body divided into three, more or less distinct parts. First, the head or front portion. Second, the thorax or middle portion. Third, the abdomen. The front of the head of the male is concave, and covered with short, stiff, brownish hair, while the head of the female is convex and covered with slight indentations, or punctures. The upper surface of the thorax in front of the middle is covered with rough or wavy elevations, while the surface back of the middle is smooth, shining, and covered with small punctures. The wing-covers (*elitra*), which encase the upper portion of the abdomen, are covered with small punctures, but not arranged in rows, as is commonly the case with species of this class of beetles. The wing-covers are also smooth and shining except near the ends where they slope down from the back, called the declivity of the elitra. Here the surface is slightly roughened by small tubercles, and thinly covered with long hairs.

A B

Fig. 28.—*The Columbian Timber Beetle.* A. Side view of male enlarged; head concave, antennae larger than in female. B, head and thorax of female, side view enlarged, head convex.

A Fig. 29. B



A Fig. 30. B

Fig. 29.—*Antennae of Columbian Timber Beetle* as they appear under the microscope. A, antenna of male; B, Antenna of female.

Fig. 30.—*Middle portion of legs, tibia.* A, tibia of middle leg; B, tibia of front leg.

In describing new species, it is usually necessary to dissect some of the individuals, and to study, by the aid of the microscope, certain parts of their anatomy; as, for instance, the antennae, or "feelers," Fig. 29. Also the feet and other parts of the front, middle

and hind legs. In every species, differences are found in the structure and markings of certain parts, which enable us to say that they are different or distinct from any other species.

The large size and peculiar form of the antennæ of this species, together with certain other distinctive characters, are only possessed by three known North American species; two others besides this one. This species differs from the other two in its larger size, finely punctured head of the female, small tubercles on the declivity of the wing-covers, and in having four spines near the tip of the tibia of the middle and hind legs. Fig. 30, A.

Classification.—The Columbian Timber Beetle belongs to an order of insects called *Coleoptera.* This order includes all of the kinds of insects known as beetles, which have hard wing cases usually extending to the tip of the abdomen. The order is separating into a large number of families, each family being made up of groups of genera having some marked characteristics common to all the species included. This species belongs to the family *Scolytidæ*, which includes, in this country, nearly 200 known species, Figs. 8, 10, 12, 14 and 26, being characteristic representatives of the family. It belongs to the genus *Corthylus*, which until recently contained but one species. The family *Scol tidæ* includes bark beetles which infest the bark of trees; timber beetles which inhabit the wood; twig beetles which breed in the terminal twigs, and root beetles which bore into and breed in the roots of certain plants.

Habits of the Columbian Timber Beetle.

Like most other timber beetles, this one, in excavating its galleries and brood chambers (the black holes), does not extend them beyond the sap-wood, and from what I have observed, it would appear that this species attacks only the healthy wood of living trees. Of the large number of their galleries examined during the investi-

Fig. 31.—*Galleries and brood chambers of the Columbian Timber Beetle*, as they occur in oak. Natural size, showing the position and character of the branching galleries, brood chambers, and end view of the surrounding stain A, inner bark; B, sap-wood; C, heart-wood.

gation, not one was found near an injury to the bark or wood. The parent beetles select the crevices and thinnest places in the bark, then bore through it and directly into the sap-wood for a short distance. Then one or more branching galleries are extended in different directions, but usually to the left or right diagonally across the grain of the wood, as shown in Fig. 31.

In oak, portions of the branching galleries often extend almost or quite parallel with the growth or layers of wood. There are usually from two to three of these branching galleries, their angle to the main entrance depending largely upon the thickness of the sap-wood of the tree attacked. In the oak, the sap-wood is usually thin, often not over one inch in thickness. Under such conditions, the galleries are like those shown in Fig. 31. When the sap-wood is thick, say two or three inches, the insect often extends the main gallery directly across the growths towards the heart until they near the heart-wood. The branches in this case are more or less parallel with the main gallery, as shown in Fig. 32. In the sides of the main and branching galleries, short side chambers occur which, in oak, extend as a rule sidewise from the main gallery, but in beech, tulip, etc., they usually extend up and down, nearly parallel with the grain of the wood. These side chambers serve as kind of cradles, or nursery chambers in which the young remain from the time they hatch until they are adults. It appears that they are excavated by the parent and that a single egg is deposited in each. The eggs soon hatch into minute footless grubs, which evidently feed upon the secretions from the wood or the sap as it flows into their chambers.

Fig. 32.—*Main and branching gallery in Beech*, showing position of galleries and character of cross section of stain.

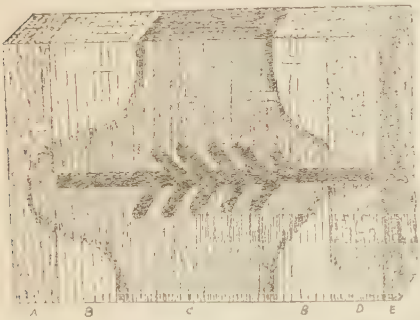


Fig. 33.—*Side view of main gallery in Fig. 32* showing position of brood chambers as they occur in Beech. A, heart-wood; B B, sap-wood; C, stain, side view; D, inner bark; F, outer bark.

As this insect has only recently been discovered, it has not been possible as yet to ascertain the time it takes for a brood to develop, or the number of broods occurring in one year. Judging, however, from what is known of the life history of species nearly related to this one, it would appear that there is not more than one or at most two broods in one season. It appears that the broods developing in the fall remain in the brood chambers or galleries until

the following spring, when they proceed to make new galleries either in the same tree or in others near by.

Character of the Injury.

It has been demonstrated that the insects infest only the sap-wood, but it does not follow that the injuries will not occur in heart-wood; in fact, they are found to be most common in the latter. The mysterious occurrence of these injuries near the heart and at different points from there to the sap-wood in large trees was clearly explained when I discovered that as the injury is made, in the healthy growing sap-wood, the annual growths or rings cover over, and seal up the entrance to the old galleries the year after they are made. Thus, the entrance to galleries made in the sap-wood of a small tree, say six or eight inches in diameter, will the following year be covered over by an annual growth of wood. In one hundred years, if the tree lives, 100 rings will have formed over the entrance. If the tree attains a diameter of say four or five feet, and the annual rings represent a growth of four or five hundred years, the first injury will occur in the heart-wood near the heart of the tree. Subsequent injuries from the same cause will be distributed through the wood at different points between the first injury and the outer sap-wood, the year in which each attack was made being accurately recorded by the annual growths formed over the original entrance. Fig. 34.

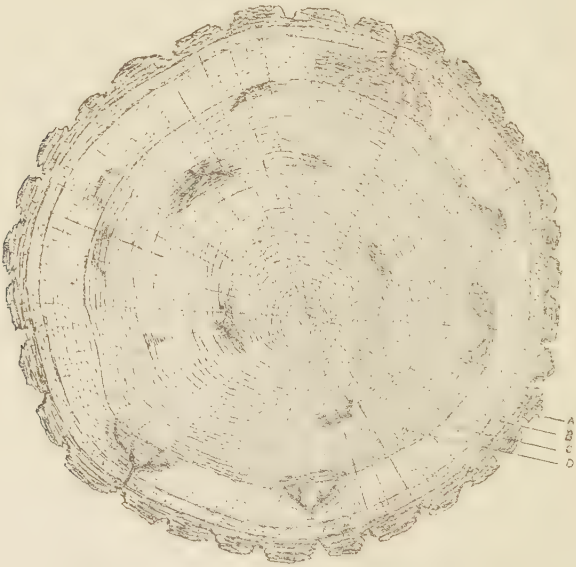


Fig. 34.—*End of Log, showing galleries made by the Columbian Timber Beetle*, and the stains as they appear at different depths in the wood; also *the four distinct parts of the trunk of a tree;* A, outer dead bark; B, inner living bark; C, sap-wood; D, heart-wood.

It will be seen by referring to Fig. 35 that the new growths as they form over the entrance, will be somewhat affected for thirty or forty years after the galleries are excavated, thus producing a curled or wavy appearance in the surface of the wood above the entrance, until the growths become normal, when all traces of the injury are obliterated in the surface of the sapwood. In some kinds of trees, however, the wound in the bark will remain distinct for 100 years, or longer, resembling old shot wounds, Fig. 36. Wounds like these are very common, in some localities, in beech bark, where they often mark the deeply buried entrance to an ancient set of galleries.

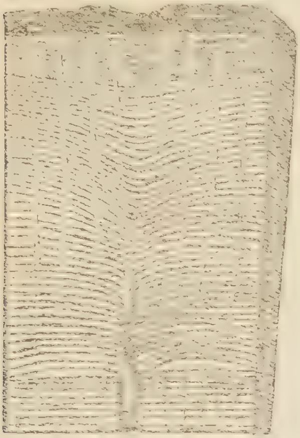


Fig 35.—*Entrance to galleries in Beech forty four years after the injury was made;* showing how the entrance is plugged up by the first and second years newly forming wood: how the subsequent growths are affected; how all traces are obliterated in the surface of the sapwood, and the original wound remaining in the surface of the outer bark.

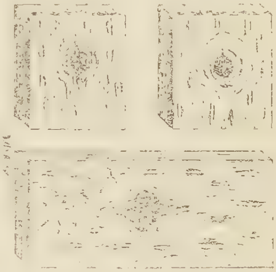


Fig. 36.—*Beech Bark*, showing wounds fifty to one hundred yrs after the beetles entered it.

It is interesting to note the effects in different woods, resulting from the presence of the injury. In oak, three or four thickened growths form over the entrance, and also over the affected wood, appearing on the end and side of a block as shown in Figs. 37 and 38. These thickened growths extend over the greater

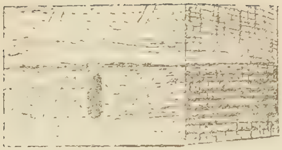


Fig. 37.—*Entrance to galleries in White Oak*: covered over by subsequent growths. as they often appear in quarter sawed lumber.

part of the wood affected by the stain, causing a raised surface which has a depression in the middle. If the split or sawed surface exposes an entrance to a set of galleries, in staves, shingles and quarter sawed lumber, the defect will appear as in Fig. 38, which shows a portion of the main gallery from which the branching ones extend, also a side view of the stain. When a piece of wood showing this character of a defect is placed in a certain position, the defects resemble somewhat minute steam monitors, the thickened light-colored growths forming the hull, the black gallery the smoke stack, and the curled condition of the wood resembling waves, while the stain represents the back ground and the smoke. I am told that this resemblance to a boat has long been noticed by stave manufacturers, and in fact that the defect is known in certain localities by the term "steamboats," the rule being that if a split or sawn stave contained more than two steamboats, it was reduced to a worthless cull.* Those in Fig. 38, drawn from specimens in our collection are good examples of the so-called steamboat defect in staves, shingles and quarter sawed lumber. This peculiar form of the defect possesses a feature differing from all of the other forms, and that is its liability to split, or crack at the point where the new growths have formed over the stains; thus rendering it, in connection with the holes a serious defect, especially in staves and shingles. The appearance of the two surfaces when thus separated at the entrance is shown in Fig. 39.

Fig. 38.

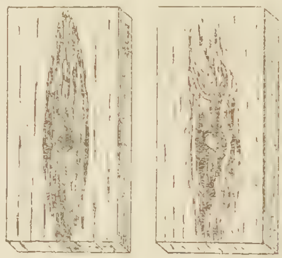


Fig 39.

Fig 38.—*Steamboats in Staves*

Fig. 39.—*Same as 37 and 38 split open*, showing at A. the appearance of the entrance; B. the appearance of the under surface of the first year's growth formed over the entrance.

The thickened growths as they occur over the stain in yellow poplar, cause a raised surface under the bark for many years after the

*W. I. Protzman, Morgantown.

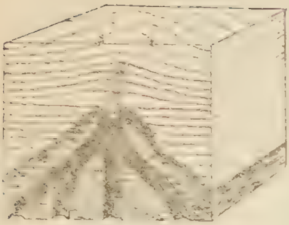


Fig 40.—*Entrance to galleries in Yellow Poplar;* showing thickened growths over the entrance, and the slightly stained condition of the wood extending a short distance above the entrance.

injury is made. This raised surface, with a distinct depression immediately above the entrance to the galleries, usually extends the full length of the stain that it covers; thus indicating the presence of the injury, until it is covered so deep that the raised surface no longer occurs.

There is a marked difference in the appearance of the stains found in elm, maple, birch, etc.; yet at the same time there is something about the injury that is characteristic of the habits of the species that will enable any one with a little study to recognize them as the work of the Columbian Timber Beetle.

The injury to the wood resulting from the attack of the beetles, consists both in the black-lined holes, and the stained condition of the wood resulting from the injury. Each of these alone, according to present inspection rules, is considered a defect in the best and medium grades of lumber. Therefore, this insect may be said to cause a double defect in timber. The defects thus caused are found to vary somewhat in character in different kinds of wood, both in regard to the arrangement of the groups of holes, and the extent of the discoloration of the wood, as observed in the sawed and plain surface of a piece of lumber. These differences are due mainly to the greater or less thickness of the sap-wood of the tree from which the lumber is taken, also to the peculiar character of the wood, and its susceptibility to change color on account of a disturbed or unhealthy condition of the sap.

Before referring to the character of injury as appearing in different kinds of wood, I will present some theories regarding the cause of the blackened walls of the galleries, and the accompanying stained condition of the wood.

We can account for the walls of the main galleries and brood chambers being black, but the exact cause of the staining of the wood for an equal distance above and below the injury may not be so easily explained. The galleries being excavated across the fiber of living sap-wood naturally results in the rupturing or separation of a certain number of pores, or ducts through which the sap flows, thus allowing it to escape into the wound. Here it is mixed with the excrements of the developing brood, which, together with the staining qualities in the sap itself when thus escaping, have the effect of coloring the sides or walls of the burrows and brood chambers, in most cases, a deep black. Hence, the application of the name black holes, to distinguish them from pin-holes.

Before attempting to give an explanation of the stained streaks accompanying the black holes, it will, perhaps, be of interest to some of our readers, who are not already familiar with the subject, to give some facts and theories regarding the growth of trees, formation of wood, movement of the sap, etc. It is important to

have some knowledge of the subject, not only to better understand the character and interesting features of this peculiar defect, but that the character of insect injuries to wood in general may be better understood.

Formation of Wood

The stem or trunk of a tree is divided into four more or less distinct parts, Fig. 34. Commencing at the outside, we find first the outer or dead bark. Second, the inner or living bark. Third, the sap-wood or living wood. Fourth, the heart-wood or matured wood.

The process of wood formation in our climate, during the life of a tree may be briefly stated as follows:—During the first year's growth from the seed, a ring of bark and wood is formed around a pith. Between the time the leaves fall in autumn and the buds commence to enlarge in the spring, there is a season of rest. Soon after the sap starts to move in the spring, material for another layer of wood commences to form between the bark and the outer portion of the wood formed the previous year. The first portion of the new growth of wood, or ring is found to be more porous and less firm than the outer portion of the ring which forms later in the season when the hardening process takes place, thus causing each ring to appear more or less distinct. The next year another layer, or ring of wood is formed in the same manner, and so on for each year as long as the tree continues to grow, a layer of wood and a layer of bark is formed; the bark beneath and the wood over the growths of the preceding year. At first, or a few years after the first year, only sap-wood is formed, through the pores of which, the water or sap necessary for the nutrition and growth of all parts of the tree is conducted. The amount of sap-wood in each case being apparently in proportion to the amount of sap required by the growing plant, and the capacity of the wood for conducting it. Thus, the wood of a rapidly growing young tree or sapling is all sap-wood and remains so until more wood is formed than is required for the purpose mentioned. At this juncture, it would appear that the sap ceases to flow through the pores of some of the first annual rings around the pith. This portion, being no longer useful to the plant in conducting sap, changes to a dark color. It may then be properly termed matured wood, as the absence of active or crude sap appears to be the cause of its changing to a darker color. This dark or matured wood is called heart-wood, on account of its first appearance around the pith or heart of the tree. The light colored wood beneath the bark is called sap-wood on account of its being that portion of the wood through which the crude sap passes to different parts of the tree. The inner or living bark is also useful in conducting sap and in contributing to the formation of a new growth of wood, which takes place between it and the outer sap-wood. The outer dead bark cracks open as the tree increases in diameter, forming deep fissures, and rough, uneven ridges, or falls off in scales as the outer layers are pushed out by the growth of wood and bark from within.

The sap-wood of the tree appears to be the most vital part of its structure, since the leaves may all be removed, as by insects, at least once during the growing season and other leaves will form the same, or the following season. In fact, at certain times of the year all of the branches may be removed and growth will continue with even greater vigor. A large number of the roots may be severed, as in the process of transplanting, and the tree survive. The heart-wood may all decay, and the tree continue to live and grow. A narrow band of bark may be removed from around the trunk of certain kinds of trees and new bark will form over the wound, and the tree live; yet if only a narrow band of all of the sap-wood be removed from around the trunk at a short distance above the ground, it will soon die. It is true that certain kinds of trees may be killed by simply cutting through the bark around the trunk, but as a rule to kill a tree by the girdling process, either a very wide band of the bark must be removed, or we must cut through all of the sap-wood.

Movement of the Sap in Trees.

One of the theories regarding the movement of the sap in trees is set forth in a general way in the following paragraph quoted from "Practical Forestry" by Andrew S. Fuller:

"All plants obtain their nourishment in a liquid or gaseous form, by imbibition through the cells of the young roots or their fibrils. The fluids and gases thus absorbed, probably mingling with other previously assimilated matter, is carried upward from cell to cell through the alburnum or sap-wood until it reaches the buds, leaves, and smaller twigs, where it is exposed to the air and light, and converted into organizable matter. In this condition, a part goes to aid in the prolongation of the branches, enlargement of the leaves, and formation of the buds, flowers, and fruit, and other portions are gradually spread over the entire surface of the wood, extending downward to the extremeties of the roots, * * As the wood and leaves ripen in the autumn, the roots almost cease to imbibe crude sap, and for a while the entire structure appears to part with moisture, and doubtless does so through the exhalations from the ripening leaves, buds, and smaller twigs, but as warm weather approaches and the temperature of the soil increases, the roots again commence to absorb crude sap and force it upward."

The upward movement of the sap in growing trees, it would seem from experiments by Sachs, McNab and Pfitzer, is at the rate of a few inches to several feet per hour. It is believed by some that this upward movement of the sap is caused both by what is termed root pressure and transpiration, or evaporation from the leaves. The following quotations are from "Botany for High Schools and Colleges," by Charles E. Bessey:

"If the root of a vigorous growing plant be cut off near the surface of the ground, and a glass tube attached to its upper end, the water of the root will be forced out, often to a considerable height * * This root pressure appears to be greatest when the evaporation from the

leaves is least; in fact, if the experiment is made while transpiration is very active, there is always for a while a considerable absorption of water by the cut end of the root, due probably to the fact that the cell walls had been to a certain extent robbed of their water by the evaporation from above."

"The flow of water (sap) from the stems and branches of certain trees, notably from the sugar maple, appears to be due to the quick alternate expansion and contraction of the air and other gases in the tissue from the quick changes of temperature. The water is forced out of openings in the stem when the temperature suddenly rises; when the temperature suddenly falls, as at night, there is a suction of water or air into the stem. When the temperature is nearly uniform, whether in winter or summer, there is no flow of sap."

Since it has been found that a dry hot day will cause rapid evaporation of moisture from a plant, which results in a correspondingly increased upward flow of sap, in turn resulting in a tendency by the roots to absorption, it would appear that this tendency of the roots to draw the sap back, is the result of its being taken faster than it can be supplied by them from the soil; consequently, a sudden change from a dry to a moist atmosphere would probably result in a downward movement of the sap through the sap-wood.

It would also appear that the downward movement in the sap-wood may be caused (as in the flow of sap from Sugar Maple) by sudden changes in the temperature and conditions of the atmosphere, as would occur from a hot day followed by a cool night. As it is not the proper place, perhaps, in this connection to discuss at further length the theories regarding the movement of sap in trees, we will proceed to a discussion of the

Causes of Stained Streaks in Wood.

The stained streaks in wood resulting from injuries to the living sap-wood of many different kinds of trees are of especial interest, from the fact, that in them evidences are found which appear to confirm certain theories regarding the movement of sap in wood.

This stained condition of the wood may possibly be the result of two causes. *First;* the wound occurring in the healthy wood has the effect of interrupting the natural movement of the sap through that portion of the wood affected by it. This may result in an unnatural, or fermented condition of the sap in and surrounding the ruptured pores, causing it to stain the cells and wood fibres with which it comes in contact. *Second;* a certain amount of the blackened, or discolored fluid occurring in the wound and penetrating the adjoining wood, not only causes the black lining but may extend for some distance into the wood, both laterally and with the grain, until it comes in contact with the active or moving sap. It is then carried with it through the wood until all the coloring or staining elements are taken up by the wood fibres and cell walls. The latter seems most probable from the fact, that it has been often demonstrated by experiment, that coloring matter injected into the wood of

growing plants will be taken up by the moving sap and conveyed through the pores, thereby staining the wood through which it passes.

It is, therefore, easy to understand why the stain extends above the wound and for a short distance on each side, since it is an admitted and well known fact that the sap moves both upward and laterally through the alburnum, or sap-wood; but, if the sap moves only upward through the sap-wood, and the downward movement occurs only in the inner bark, and between this and the outer sap-wood, as we would infer from authoritative writers on botanical questions, the downward extension of the stain would not be so easily explained. This condition of the stained streak is therefore evidence that the theory regarding a downward movement of the sap in the sap-wood is not entirely without foundation; in fact, as most of these stained streaks extend an equal distance above and below the injury, it would indicate that the downward movement of fluid in the sap-wood may be nearly in the same proportion as the upward movement.

Character of the Injury in Oak.

The characteristic form and appearance of the galleries of the Columbian Timber Beetle, as excavated in oak wood, are shown in Figs. 31, 34, 37, 38, 39, and on title page.

In order that the beetles may extend their galleries the desired distance through oak wood, they must proceed to the right or left, soon after they enter the first layers of wood to avoid, coming in contact with the heart-wood which appears to be objectionable to them. Thus, a portion of the branching galleries usually extends at right angles to the entrance, and while the brood chambers may extend in any direction, they, as a rule, extend sidewise from the main and branching galleries, Fig. 31. Thus, the injuries occurring in oak, as observed in a piece of sawed or dressed lumber, show from two to eight or more holes arranged in a row directly across the grain of the wood, See title page. The stain accompanying them extends only from two to eight inches above and below the holes. The extent of the stain streaks is usually in proportion to the number of holes. When there is only one hole, the streak will be found narrow, and when a greater number occur, the stain will be broad in proportion.

It will be seen by reference to Figs. 31 and 34 that the appearance of the injuries in a piece of lumber depends largely upon how the piece is sawed from the log. If, as in the usual manner, the log is first squared and all the boards cut from one side, the holes in the middle of all the boards except those near the heart will usually occur in rows, and will not as a rule extend through a board over one inch in thickness. In the edge of the boards, however, and in those from near the heart, the reverse condition will be found; that is, single holes extending through two or three one-inch boards.

In what is known as quarter sawed oak, there is seldom more

than one or two holes in a place, but these may show on both sides of a piece three or four inches in diameter, or in other words, single holes from one gallery may occur in three or four one-inch boards taken successively from the same log. The same galleries would show seven or eight holes in a row in one or possibly both sides of a one inch board sawed in the usual manner, and the adjoining boards would show only a trace of the stain with possibly one or two shallow holes. Thus, by the character and location of the holes in a board or piece of timber, we can usually tell what position the piece occupied in the log.

In staves and shingles which are split, or riven from cuts of logs in the same manner as quarter sawing, one hole may extend through one or two staves, or through a dozen shingles taken successively from one piece, thus rendering them nearly or quite worthless; since the peculiar character and form of the holes make all attempts to plug them unsuccessful. The black holes differ in this respect from pin holes which can be successfully plugged with small wooden pins.

If a living tree affected with black holes is found to be otherwise sound and healthy, which is usually the case, the stained wood surrounding the holes will be just as sound as that adjoining. This is necessarily the case from the fact that the entrance to the holes are sealed up by the new growth soon after they are vacated by the beetles. Hence they are protected from outside influences which would otherwise cause an unsound condition of the wood. If, on the other hand, a tree containing the defects is unsound in any part, the stained wood is liable to be affected by the decay more than that surrounding it.

The stains are also liable to be unsound in the wood of standing dead trees, or of logs and felled trees which have been allowed to lie on the ground more than one year. At least, the stains appear to be more susceptible to decay, in lumber or timber cut from such logs, than from logs recently cut from sound, living trees.

I have found that when the black hole stains occur in sound lumber of good quality, the stains are dark and bright, and that the wood thus affected is as sound as that adjoining them. I have also found that when they occur in lumber from dead trees or old logs, the stains as a rule are light and dull. Heretofore, it has not always been possible to judge whether or not a piece of lumber or timber had been cut from a dead tree, old log or living tree, or whether or not the piece is in a condition to resist decay.

It would therefore appear that we have, in the stains accompanying black holes, another interesting feature regarding this peculiar injury, and one which may be utilized to advantage, namely, an index to the quality of timber and lumber in which they occur. If it is found upon further observations to be the rule that the stains in sound wood of the best quality are dark and bright, and that those occurring in lumber of inferior quality are light and dull, the defects will not be without some redeeming qualities, and would be entitled to a distinctive name. Therefore I will here suggest Co-

lumbian stains as a proper term to distinguish the stained wood accompanying the galleries of the Columbian Timber Beetle from "wind shake" stains, knot stains and discolored sap.

Extent and Distribution of the Trouble in Oak.

As has been previously stated, the defects caused by the presence of black holes in oak wood, are so very common that it is difficult to find any considerable quantity of this lumber which is entirely free from them. Since I have been investigating the subject, I have been surprised to find how extensively wood showing these defects is being used by cabinet makers and carpenters. It is not uncommon to find from ten to twenty of the injuries in a piece of oak furniture. They are frequently observed in wainscoting and other natural wood finishes where oak is used. They are common in oak flooring, joists, and square timber; in wood used in the construction of railroad trestling, bridges, etc. In a railroad trestling of considerable length recently examined, scarcely a piece of timber could be found that did not show more than one of the defects, and in some of the main posts nearly 100 separate groups of the holes were counted. They are also common in railroad ties, and immense quantities of timber are lost in the manufacture of staves, shingles, etc., on account of the holes which are exceedingly objectionable defects in material of this character.

It appears that the timber from certain localities, and exposures, is affected by this trouble more than it is in others. It would also appear from what I have learned by inquiry, and from my own observation, that the difference in the amount of timber affected on an east and west exposure is quite marked; timber from the latter being often seriously injured, while that from the former is almost, or quite free from injury. It also appears that timber in the valleys is affected more than that on the tops of the hills and mountains.

In regard to the distribution of this trouble in the United States, I have little means of judging. I have, however, observed the defects in lumber from Michigan, which would indicate that the insect is not confined to any restricted locality.

Estimated Losses From the Defects in Oak.

According to the inspection rules governing the grading of hardwood timber and lumber having a commercial value, the black holes and stains are considered defects not allowable in the higher priced grades. Therefore when they occur in a piece of lumber or timber, its value is reduced on this account at the rate of $5 to $20 per thousand feet. As a rule these defects occur in wood having no other defect, or in lumber which would otherwise be placed in first and second grades. Thus, one million feet of lumber reduced to lower grades (commons and culls) would on this account represent a depreciated value of at least $10,000 below the selling price of first and second grades. It has been estimated by good authority that 50

to 75% of the White and Chestnut Oak, in certain localities, is more or less affected with this trouble.

The expense of handling, shipping and marketing the lower grade is just as much as if the material was of the higher grade; therefore there must be serious loss on account of this trouble, sustained by some one during the process from the standing timber until the lumber reaches the consumer; the greatest loss being evidently sustained by the owners of the timber and the manufacturers of timber products.

Methods of Preventing Loss.

When we come to consider methods of preventing loss from the insect injuries we have been discussing, we are met with a number of difficulties not found with injuries ordinarily caused by insects. In the first place, the injuries by the Columbian Timber Beetle, and especially those causing the greatest loss, were caused from 50 to 300 years ago; hence, it is an injury to deal with, the nature of which permits only of the use of expedient methods. Therefore, in order to avoid loss on its account, we must resort to methods of utilizing to the best advantage the affected material.

Suggestions for the Utilization of Affected Material.

The extent to which a given defect will damage or reduce the value of a piece of lumber depends largely upon what the piece is intended for, or to what use it is best adapted. A defect in a piece of lumber manufactured for certain uses may reduce its value to that of a mill cull, while the same thing in a piece intended for certain other uses would not be considered defects even in the best grades, because it would not be a detriment to the manufactured article in which the piece is to be used. Therefore, while the black holes and Columbian stains may be defects in lumber intended for one purpose, they may not be so in lumber intended for some other purpose, and possibly may be even desirable in material required for some of the many and varied articles manufactured from oak wood.

Considering the subject from this standpoint, it appears to us that all of the oak timber, in which the black holes and stains are the only defects, could be manufactured into material that would not be depreciated in value on this account much, if any, below that of first and second grades.

As has been demonstrated, the black holes more often occur in the best and soundest wood of a tree, and the stained wood resulting from this injury is usually just as sound as the wood adjoining it; therefore, if the same care is exercised in handling lumber affected with black holes, as is done with clear lumber to prevent damage from blueing, etc., the Columbian stains will remain sound, and would not be any more of a detriment, and in many cases less so than clear sap. Clear sap being allowable in first and second grades, especially in material to be used for inside work and in arti-

cles to be varnished and painted, there is no real reason why black holes and bright Columbian stains should not, to a certain extent, be allowed in the better grades of lumber intended for like uses.

If it could be clearly demonstrated that the black holes are not detriments to lumber intended for certain uses, requiring best and high priced grades, and rules should be adopted by the hardwood lumber associations, allowing them in the best grades of certain specified material, it would add very considerably to the income of owners of oak timber, and to the profits of the manufacturers of lumber from the same, and no one, if the lumber was utilized for the purpose intended, would be the loser. As a rule, whatever adds to the value or selling price of a natural product, adds just so much to the prosperity of the region or state having a large amount of the same. Therefore, the question of how to prevent depreciation in value of lumber manufactured from affected timber is an important one, worthy of careful consideration.

If information could be had, through discussions at meetings of lumber associations, from experts in the different uses of oak lumber, and from consumers regarding the several kinds of articles and work in which such lumber could be used without detriment; then a list of such uses, with dimensions of the lumber suitable for the same, could be published in a bulletin of this kind, or in timber journals. The information gained would thus be available for owners of timber and manufacturers of lumber, and the affected timber could be manufactured into dimensions suitable for some of the specified uses.

Means of Detecting Affected Trees and Logs

During the investigation, I have discovered some means of detecting trees that are affected with black holes and stains, and for indicating the extent of the trouble in freshly cut logs. It was found that the bark of trees attacked last spring and summer showed dark, wet stains extending one to four or more inches below the hole in the bark where the insect entered. These stained spots can often be seen when the observer is a considerable distance from the tree. If there are many of them visible on a tree, we may safely conclude that the wood throughout is more or less affected with the trouble, since it appears that a given tree may be the host of generation after generation of the beetle, and that once the tree is attacked, successive broods may continue to utilize it for the perpetuation of their species. This is not the universal rule, since, on account of the scarcity of the insects some years, trees previously attacked will not show any outward indications.

There is another, and perhaps more reliable means of detecting affected timber, and that is to examine the ends of the logs directly after they are sawn off, when, if the logs are affected to any great extent, a number of the stained spots, (the ends of the stained streaks) will show on the freshly cut surface as in Fig. 34. If there are many of these stained spots in the end of a log, it is a sure indi-

cation that the log is badly affected with them throughout. Before such logs reach the saw mill, however, the stained spots will be obliterated by the action of the weather, dirt, etc. Therefore, if such logs were branded, as they are cut, with some peculiar mark, it would indicate to the sawyer at the mill, the character of the log and the kind of lumber to be expected from it. Thus, trees indicating the presence of the defects, by the stained spots on the bark, could be cut into logs suitable for certain desired dimensions, and the branded logs could be utilized to the best advantage with very little additional expense.

Suggestions Regarding Proper and Improper Uses of Columbian Lumber.

The different grades of lumber designated in inspection rules, are referred to by some distinctive name; therefore, in order to distinguish lumber and timber having no other defects than black holes and Columbian stains, I would suggest the name Columbian, to be applied to a grade which would include lumber and timber of all kinds and dimensions, in which black holes, and bright sound stains are the only defects.

It is evident that while there are certain kinds of structures and articles, which will properly admit of the use of Columbian lumber, there are other purposes for which such lumber should never be used.

Columbian Oak should not be used in articles requiring wood of special strength, as in wagons, agricultural implements, and in important timbers in buildings, bridges, trestling, etc. It should not be used to any great extent in structures, or articles which are to be exposed to the weather, unless thoroughly protected by paint, or with other substances which would prevent the holes and stains from absorbing and retaining moisture. It appears, however, that if a piece of timber is tough and otherwise of the best quality, it may contain many of the holes and stains, and yet withstand the action of the weather, unprotected by paint, longer than some of the unaffected pieces, especially if the latter are of a brash and inferior quality. In fact, I have observed certain posts in an old railway trestling in which the stains were perfectly sound, while in other posts they were in an advanced stage of decay. Thus, it will be seen that if the Columbian timber is to be used at all in such structures, good judgment should be exercised in its selection, and only those pieces indicating that the wood is of the best quality, and most capable of resisting decay, should be used.

Oak wood containing light colored or unsound stains should not be used for joists, sills and like material, which are to be placed where the conditions will favor "dry rot," nor in any important structure requiring strong and durable timber, or in structures, the wood-work of which is exposed to the weather, unless thoroughly painted, and even then such timber is liable to premature decay on account of the unsound stains beneath the surface.

Columbian heading, shingles, staves and like material are as a rule to be considered worthless culls, or at best low grade material, since the holes cannot be successfully plugged, and staves containing them are liable to split when bent.

There are a great many uses requiring only second and low grade lumber and timber in which Columbian lumber may be properly used and for which it is now being extensively utilized. In truth, a large amount of otherwise first-class timber is annually being manufactured into low priced material suitable for such uses.

It is not of the common uses admitting of cheap grade material to which I wish to call attention, but to uses requiring high priced grades, which will properly admit of Columbian lumber without detriment to the finished articles.

It may be of interest to owners of timber, manufacturers of lumber and dealers in the same to know, that an immense amount of Columbian lumber is daily being used in structures, and manufactured articles, which are supposed to contain the higher priced grades. In order for any one to satisfy himself on this point, he has only to look around him a little, and will no doubt be surprised to find the remarkably common occurrence of the holes and stains in oak furniture, natural wood finish and wooden structures, and that there is in reality very little prejudice or objection to the so-called defects, expressed by purchasers and owners of finished work. In fact, I agree with carpenters and cabinet makers, with whom I have frequently discussed the subject, that the stains give a certain variety, and antique appearance to the wood, together with an indication of its genuine character and quality, which is really desirable and to be admired. I should not be at all surprised if in the near future there would be a demand for this grade of lumber on account of a freak of fashion in furniture and natural wood finish, which would demand the presence of some of the Columbian stains in every piece.

Since the owners of timber suffer serious loss from the depreciation in value of their timber and lumber on account of the so-called defects, and since the purchasers and owners of finished articles manufactured from wood, allow, without complaint, the extensive use of such material in expensive work, it appears that the owners of timber and the manufacturers of timber products should derive some benefit from this state of affairs, which would result in the enhancement of one of our important natural products.

Character of the Injuries in Yellow Poplar.

Oct. 12th to 13th and Dec. 30th, '93, to Jan. 1st, '94, were spent in a poplar lumber region in this State for the purpose of investigating a peculiar defect locally known as "Calico Poplar," which was found to be caused by this Columbian Timber Beetle. In this wood, the stains instead of extending only a few inches above and below the holes, as in oak, often extend several feet in both directions. When the defects occur at all frequently in a poplar tree, the

extended stained streaks run together, which often results in a beautiful combination of colored wood, such as black, brown, purple, blue, etc. See Plate II. Since this condition occurs in the most valuable part of the tree, the wood so affected is rendered unmerchantable, or at least in commercial value, greatly reduced. The illustration will give an idea of the appearance of lumber affected in this way, after it is dressed and arranged in a panel. It will be seen that the effect is very striking. The photograph, however, does not convey an idea of the colors.

The conditions appear to be more favorable for the development of the beetle in this wood than in the other kinds of wood infested by it. The branching galleries are found to be more numerous, and the brood chambers to occur, as a rule, in greater numbers. The form of the galleries as occurring in this wood, is shown in Fig. 41. The side or brood chambers almost invariably extend up and down from the branching galleries; hence the holes, as they appear in the surface of a piece of lumber differ from those observed in oak, in that there are seldom over four holes in one place and that often full length brood chambers will appear as in Fig, 42.

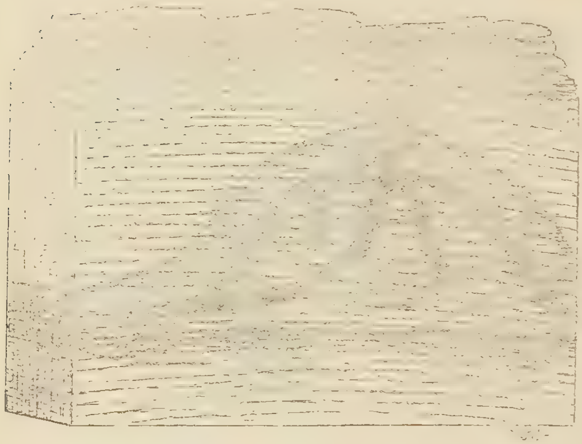


Fig. 41.—Character of galleries in Yellow Poplar.

Fig, 42.—*Brood chambers* as they appear in Poplar and Beech.

PLATE II.

W. E, Rumsey Photo,

COLUMBIAN POPLAR---Five Boards 1-2 Ft. X 5 Feet.

The sap-wood of Yellow Poplar being usually not over one or two inches thick, the holes from one set of galleries do not extend very far in any direction; hence, do not show on both sides of a plank over two inches thick.

The great distance to which the stains extend above and below the holes, is a very marked characteristic in this wood, making it easy to judge if a freshly cut log is much affected by the trouble, since if very many of the stains occur in a log, say 16 ft. long, both ends will show numerous dark spots as in Fig. 34.

Distribution and Losses.

I have not as yet been able to satisfactorily ascertain the extent to which the trouble exists in the several poplar regions of the State, but from my observation, and from what I can learn, it appears to be confined to certain restricted localities and exposures. In such localities the depreciated value of the products from the affected timber has been such as to cause the receipts to fall below the cost of production; hence, in some cases it has been found best to allow the timber to stand, rather than attempt to convert it into lumber.

It would appear that the depreciation in value is due more to prejudice than to any real detriment to the lumber. The stains most frequently occur in the choicest part of the tree, and in lumber which would otherwise pass as first-class. The stained portion, as a rule, is just as sound as the unaffected wood; yet boards affected as those illustrated in the plate are reduced in value, on this account, from No. 1 grade to a mill cull, or at the rate of $15 to $20 per thousand feet.

Utilization of Columbian Poplar.

Whether or not Columbian Poplar could be utilized in the same manner as Columbian Oak and with as pleasing effects, I will leave my readers to judge. I have had some of this Columbian (Calico) Poplar prepared both in stained and natural wood finish, the effect being both interesting and attractive, and it seems to me that the apparently limited quantity of poplar timber, affected in this manner, could be utilized without having its value depreciated much below that of first and second grades.

Remedies.

The injury caused by the Columbian Timber Beetle is a peculiar one, differing from those ordinarily caused by destructive insects in so much that a remedy for the trouble, so far as benefitting this generation, is not to be found in methods of destroying the insects or preventives against its attack. This is evident from the fact that the defects as observed in lumber and timber are some of them centuries old, and all of them occurring in heart-wood were excavated at least forty or fifty years ago. It is also evident that if all the Col-

umbian Timber Beetles were destroyed now, the present generation would not derive much benefit from their extinction, from the fact that injuries caused by them this year will scarcely be out of the sap-wood fifty years hence. Therefore, it seems more proper that we should look to methods of utilizing to the best advantage the defective timber and lumber and to treatment of the affected wood to prevent premature decay. As we have already discussed the former methods, I will offer only a few suggestions regarding the treatment of the stains and holes, the object being to either protect them from catching and retaining moisture, or to counteract their detrimental appearance. As a protection there is nothing, perhaps, better to use than linseed oil, paint, coal tar, etc., which if applied to stains that are not perfectly sound, will tend to preserve and protect that portion of the wood from unnatural moisture and premature decay. As a filter, there is nothing better, perhaps, than putty with which to fill the holes. There is one mistake with regard to the use of the putty, for this purpose to which I desire to call attention, and that is instead of staining it the color of the natural wood, or using it without coloring, as is the common practice, it should be colored to correspond with the stain surrounding the holes.

Natural Enemies of the Beetle.

No very accurate information regarding the natural enemies of this insect has yet been determined. I have found, however, during the investigation, that a large per cent. of the hundreds of galleries examined, in which broods of beetles developed last summer, were occupied by a small white maggot, Fig. 43, and in no case were live beetles or young found in the galleries thus infested. On one or two occasions, I found some of these maggots within the dead bodies of beetles, but whether or not it is a true enemy of the beetle, or merely inhabits the vacated galleries to feed upon the escaping sap, and dead beetles, I would not say.

Figure 43.—*Maggot*, or *fly larva*, from galleries of Columbian Timber Beetle greatly enlarged.

The European Bark Beetle Destroyer, which we have been introducing from Germany as an experiment, with reference to the ravages of bark beetles in the pine and spruce forests, would readily attack and devour the adults of the Columbian Timber Beetle if they met with them. It is not probable, however, that they would seek for them on oak and other deciduous trees to a sufficient extent to render much benefit, since this European insect is more inclined to feed upon the bark beetles which inhabit the pine and spruce.

There are numerous other predaceious insects, however, which would likely attack it both in and out of its galleries, but to what extent these species reduce its numbers or prevent its increase, has not been determined.

Conclusions.

In concluding this account of a common insect injury to wood, I may say that the investigation has proven a most interesting one, regarding which there is yet much to learn, and much that is suggestive of the importance of a better knowledge of all common things around us. In fact, one of the objects of this bulletin is to call the attention of our readers to the necessity of a more critical observation of the annoying, destructive, beneficial and mysterious elements of nature.

Common objects, the nature of which, little if anything is known, may be of no interest to the general observer from the very fact that they are common, and that nothing interesting or pleasing is known about them. If it is a thing that causes trouble or loss of time and property, it is natural for persons to fail to see anything pleasing or attractive, even when it is demonstrated that it has some interesting features, but on the other hand, let it be shown that the object has a commercial value, and opinion will soon change.

May not the conditions resulting from the attack of the Columbian Timber Beetle prove to be an example of this kind? The injuries are of such frequent occurrence in different kinds of common wood that they are not noticed by persons who are in no way affected by them. They have heretofore been looked upon as nothing but worm holes, supposed to be attended by streaks of unsound wood. Dealers in timber products, however, object to discolored wood and insect injuries, especially when making a purchase, claiming that they are all defects which must depreciate the value of the material. Owners and producers must dispose of such products at a reduced price; buyers are necessarily prejudiced against defects, thus affecting the receipts from their investments. That there are numerous interesting features with reference to the Columbian Timber Beetle, and the conditions resulting from its breeding in living sapwood is evident. That the presence of the so-called defects is not always detrimental but on the contrary of economic importance is equally evident. Therefore, with our present knowledge of the subject, shall we think it improbable that instead of being considered defects, they may, as seen in natural wood finish, serve as pleasing objects to draw our attention to nature and her handiwork?